PROCEEDINGS

OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY

OF LONDON.

1905, vol. II.

PART I.

CONTAINING PAPERS READ IN

MAY AND JUNE.

OCTOBER 1905.

PRINTED FOR THE SOCIETY,
SOLD AT THEIR HOUSE IN HANOVER SQUARE.

LONDON:
MESSRS. LONGMANS, GREEN, AND CO.,
PATERNOSTER-ROW.

[*Price Twelve Shillings.*]

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1905.—Vol. II.

Part I.

May 2, 1905.

May 16, 1905.

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THE ZOOLOGICAL SOCIETY OF LONDON.

This Society was founded in 1826 by Sir Stamford Raffles, Mr. J. Sabine, Mr. N. A. Vigors, and other eminent Naturalists, for the advancement of Zoology and Animal Physiology, and for the introduction of new and curious subjects of the Animal Kingdom, and was incorporated by Royal Charter in 1829.

COUNCIL.

The Society consists of Fellows, and Honorary, Foreign, and Corresponding Members, elected according to the By-Laws.

The Gardens in the Regent's Park are open from Nine o'clock A.M. till Sunset.

The Offices (3 Hanover Square, W.), where all communications should be addressed, are open from Ten till Five, except on Saturdays, when they are closed at Two o'clock P.M.

The Library (3 Hanover Square), under the superintendence of Mr. F H. WATERHOUSE, Librarian, is open from 10 A.M. to 5 P.M., on Saturdays to 2 P.M. It is closed in the month of September.

The Meetings of the Society for General Business are held at the Office on the Thursday following the third Wednesday in every month of the year, except in September and October, at Four P.M.

The Meetings for Scientific Business are held at the Office twice a month on Tuesdays, except in July, August, September, and October, at half-past Eight o'clock P.M.

The Anniversary Meeting is held on the 29th April, at Four P.M., or the nearest convenient day (April 28, 1905).

TERMS FOR THE ADMISSION OF FELLOWS.

FELLOWS pay an Admission Fee of £5, and an annual Contribution of £3, due on the 1st of January, and payable in advance, or a Composition of £30 in lieu thereof; the whole payment, including the Admission Fee, being £35.

No person can become a FELLOW until his Admission Fee and First Annual Subscription have been paid, or the annual payments have been compounded for.

FELLOWS elected after the 30th of September are not liable for the Subscriptions for the year in which they are elected.

PRIVILEGES OF FELLOWS.

FELLOWS have Personal Admission to the Gardens with Two Companions daily, upon signing their names in the book at the entrance gate.

FELLOWS receive a Book of Saturday and a Book of Sunday Orders every year. These Orders admit *two* persons to the Gardens on each

Saturday and *two* on each Sunday in the year. But the Saturday Orders are *not* available if the FELLOW shall have used his privilege of *personally* introducing two companions on the *same day*.

FELLOWS also receive every year Twenty Free Tickets (Green), each valid for the admission of one adult any day of the week, including Sunday. Children's Tickets (Buff) can be had in lieu of Green Tickets in the proportion of two Children's Tickets to one Adult's. These Tickets, if not made use of in the year of issue, are available for following years.

In no case can two children be passed through the gates as one adult.

FELLOWS, if they wish it, can exchange the Book of Saturday Orders for Twenty Green Tickets available for any day. The Book of Sunday Orders can also be exchanged for a similar packet of Twenty Tickets. These books must, however, be returned entire, and the exchange can only be made during the year of their issue.

The annual supply of Tickets will be sent to each FELLOW on the 1st of January in every year, on his filling up a form of Standing Order stating in what way they should be made up, and to what address they should be sent. Forms for this purpose are supplied on application.

The WIFE of a FELLOW can exercise all these privileges in his absence.

FELLOWS have the privilege of receiving the Society's Publications on payment of the additional Subscription of One Guinea every year. This Subscription is due upon the 1st of January and must be paid *before* the day of the Anniversary Meeting, after which the privilege lapses. FELLOWS are likewise entitled to purchase the Transactions and other Publications of the Society at 25 per cent. less than the price charged to the public. A further reduction of 25 per cent. is also made upon all purchases of Publications issued prior to 1871, if above the value of Five pounds.

FELLOWS also have the privilege of subscribing to the Annual Volume of the Zoological Record for a sum of £1, payable on the 1st July in each year, but this privilege is forfeited unless the subscription be paid *before* the 1st of December following.

FELLOWS may obtain a TRANSFERABLE IVORY TICKET admitting Two Persons, available throughout the whole period of Fellowship, on payment of Ten Pounds in one sum. A second similar ticket may be obtained on payment of a further sum of Twenty Pounds.

Any FELLOW who intends to be absent from the United Kingdom during the space of one year or more may, upon giving to the Secretary notice in *writing*, have his name placed upon the "dormant list," and will be thereupon exempt from the payment of his annual contribution during such absence.

Any FELLOW, having paid all fees due to the Society, is at liberty to withdraw his name upon giving notice in *writing* to the Secretary.

Ladies or Gentlemen wishing to become Fellows of the Society are requested to communicate with the undersigned.

P. CHALMERS MITCHELL, M.A., D.Sc.,
Secretary.

3 Hanover Square, London, W.,
October, 1905.

MEETINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON

FOR

SCIENTIFIC BUSINESS.

(AT 3 HANOVER SQUARE, W.)

1905.

TUESDAY, NOVEMBER 14 and 28 | TUESDAY, DECEMBER 12

1906.

TUESDAY,	JANUARY 16	TUESDAY,	APRIL .. 10
,,	FEBRUARY 6 and 20	,,	MAY .... 1, 15 and 29
,,	MARCH .. 6 ,, 20	,,	JUNE 19

The Chair will be taken at half-past Eight o'clock in the Evening precisely.

LIST OF THE PUBLICATIONS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.

THE scientific publications of the Zoological Society of London are of two kinds—"Proceedings," published in an octavo form, and "Transactions," in quarto.

According to the present arrangements, the "Proceedings" contain not only notices of all business transacted at the scientific meetings, but also all the papers read at such meetings and recommended to be published in the "Proceedings" by the Committee of Publication. A large number of coloured plates and engravings are issued in the volumes of the "Proceedings," to illustrate the new or otherwise remarkable species of animals described in them. Amongst such illustrations, figures of the new or rare species acquired in a living state for the Society's Gardens are often given.

The "Proceedings" for each year are issued in four parts, on the first of the months of June, August, October, and April, the part published in April completing the volume for the last half of the preceding year. From January 1901 they have been issued as two half-yearly volumes.

The "Transactions" contain such of the more important communications made to the scientific meetings of the Society as, on account of the nature of the plates required to illustrate them, are better adapted for publication in the quarto form. They are issued at irregular intervals.

Fellows and Corresponding Members, upon payment of a Subscription of One Guinea *before* the day of the Anniversary Meeting in each year, are entitled to receive the Society's Publications for the year. They are likewise entitled to purchase the Publications of the Society at 25 per cent. less than the price charged for them to the Public. A further reduction of 25 per cent. is made upon purchases of Publications issued prior to 1881, if they exceed the value of five pounds.

Fellows also have the privilege of subscribing to the Annual Volume of the Zoological Record for a sum of 30*s*. (which includes cost of delivery), payable on the 1st July in each year; but this privilege is forfeited unless the subscription be paid *before* the 1st of December following.

The following is a complete list of the publications of the Society already issued.

[*October*, 1905.]

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List of the Vertebrated Animals now or lately Living in the Gardens of the Zoological Society of London. (Ninth Edition.) 8vo. 1896. Cloth, 6s.; Paper, 5s.

Catalogue of the Library of the Zoological Society of London. (Fifth Edition.) 8vo. 1902. Cloth, 6s.; Paper, 5s.

These publications may be obtained at the SOCIETY'S OFFICE (*3 Hanover Square, W.*), *at Messrs.* LONGMANS' (*Paternoster Row, E.C.*), *or through any bookseller.*

THE ZOOLOGICAL RECORD.

THE object of the Zoological Record is to give, by means of an annual Volume, complete lists of the Works and Publications relating to Zoology in all its branches that have appeared during the year preceding the issue of the Volume, together with full information as to the points they deal with, arranged in such a manner as to serve as an Index to the literature of Zoology in all parts of the globe, and thus to form a repertory that will retain its value for the Student in future years.

The 'Zoological Record,' after Vol. 40, will be published by the Society at the price of 40*s*. per volume. But all Members of the Zoological Society of London will have the privilege of receiving it, including the cost of delivery, at a subscription price of 30*s*. per annum. This Subscription is due on the 1st of July in every year, and the privilege of Subscription is forfeited unless the amount be paid before the 1st of December following.

The Zoological Society, having purchased the entire stock of the 'Zoological Record,' is able to supply complete sets. The thirty-seven Volumes to the end of the nineteenth century, and the Index-Volume (1880–1900) in addition, will be supplied for £15 net (or *without* the Index-Volume, for £14 10*s*. net). Volumes of any single year (exclusive of the last five volumes and Vol. 6) can likewise be supplied at 10*s*. per volume net.

The price of the Index Zoologicus (Index-Volume 1880–1900) is 20*s*., to Fellows 18*s*.

Members of the Society wishing to subscribe to the 'Record' are requested to apply at this office for a Form, to be returned when filled up and signed by the subscriber. In order to facilitate the payment of the subscription, a Banker's Order Form is also supplied to those who prefer that mode of payment. This order, when filled up and signed, should be sent to the Society's office for registration; it will then be sent to the Agents named therein.

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On receipt of the price any Division will be forwarded as soon as ready.

These separate Divisions can be obtained from the Zoological Society, 3 Hanover Square, London, and also from the following Agents: Friedländer & Sohn, 11 Carlstrasse, Berlin; Librairie A. Hermann, 6 rue Sorbonne, Paris. Cheques and Post-Office Orders should be made payable to "The Zoological Society," and crossed "Drummond's."

P. CHALMERS MITCHELL,
Secretary.

October, 1905.

ZOOLOGICAL SOCIETY OF LONDON,
3 HANOVER SQUARE, W.

LIST OF VOLUMES OF THE 'ZOOLOGICAL RECORD.'

The Record of Zoological Literature, 1864–1868, Vols. I.–V. Edited by ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.Z.S., &c. Price 10s. each Volume. Net.

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The Zoological Record, Volume the Thirty-seventh; being Records of Zoological Literature relating chiefly to the year 1900. By J. A. Thomson, R. Lydekker, R. Bowdler Sharpe, G. A. Boulenger, W. A. Herdman, E. R. Sykes, E. A. Smith, G. C. Crick, A. W. Brown, D. Sharp, F. A. Bather, A. Willey, and E. A. Minchin. Edited (for the Zoological Society of London) by DAVID SHARP, M.A., F.R.S., F.Z.S., &c. London, 1901. Price 30s.

The Zoological Record, Volume the Thirty-eighth; being Records of Zoological Literature relating chiefly to the year 1901. By J. A. Thomson, R. Lydekker, R. Bowdler Sharpe, G. A. Boulenger, Alice L. Embleton, E. R. Sykes, E. A. Smith, S. Pace, Albert Brown, D. Sharp, F. A. Bather, and E. A. Minchin. Edited (for the Zoological Society of London) by DAVID SHARP, M.A., F.R.S., F.Z.S., &c. London, 1902. Price 30*s*.

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The Zoological Record, Volume the Fortieth; being Records of Zoological Literature relating chiefly to the year 1903. By D. Sharp, R. Lydekker, R. Bowdler Sharpe, G. A. Boulenger, W. T. Calman, E. R. Sykes, E. A. Smith, Alice L. Embleton, F. A. Bather, E. A. Minchin, and H. M. Woodcock. Edited (for the Zoological Society of London) by DAVID SHARP, M.A., F.R.S., F.Z.S., &c. London, 1904. Price 30*s*.

Index Zoologicus. An alphabetical list of names of genera and subgenera proposed for use in Zoology, as recorded in the Zoological Record, 1880-1900; together with other names not included in the 'Nomenclator zoologicus' of S. H. Scudder. Compiled (for the Zoological Society of London) by CHARLES OWEN WATERHOUSE and edited by DAVID SHARP, Editor of the Zoological Record. London, 1902. Price to Fellows, 18*s*.; price to the public, 20*s*.

These publications may be obtained at the SOCIETY'S OFFICE *(3 Hanover Square, W.).*

PROCEEDINGS

OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.

1905, Vol. II. (May to December).

May 2, 1905.

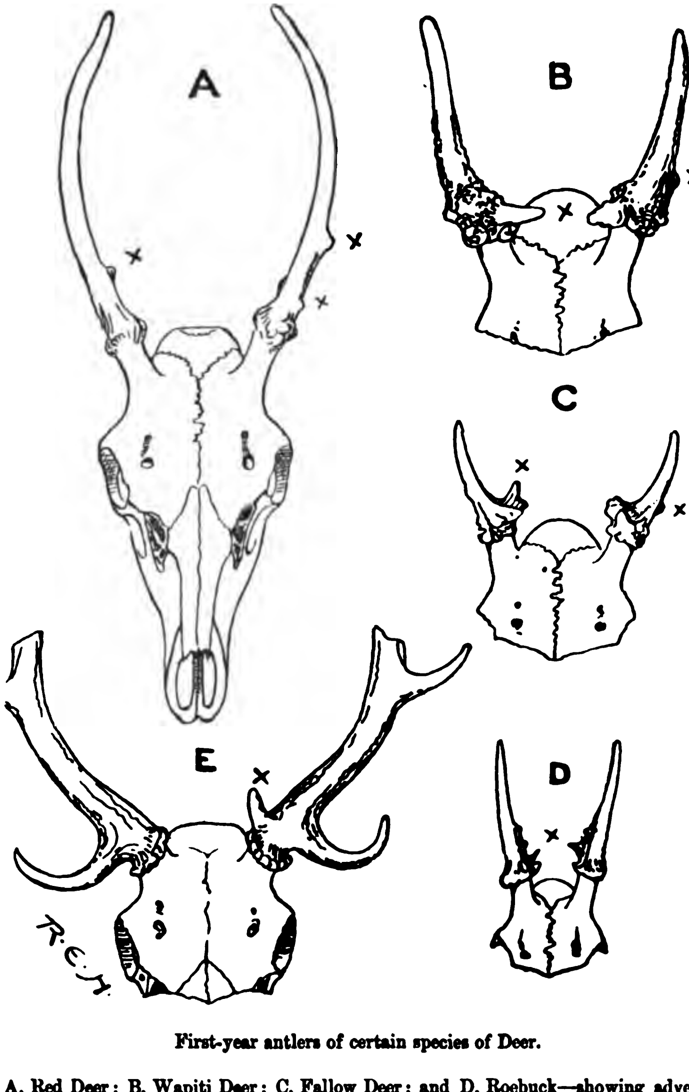
Dr. W. T. Blanford, C.I.E., F.R.S., Vice-President, in the Chair.

The Secretary exhibited three large photographs (now in the Society's Library), presented to the Society by Mr. Howard B. Turner, of Hippopotamuses swimming in a river in their native haunts.

Mr. R. E. Holding exhibited and made remarks upon a series of antlers of the first year of the Roebuck, Red Deer, Fallow Deer, and Wapiti. The exhibit had special reference to a paper read by Mr. Martin A. C. Hinton at the meeting of the Society held on March 21st, on some antlers of the Red Deer (*Cervus elaphus*) which were obtained from the Post-Pliocene deposits in the South of England, and in which it was stated that "these antlers belonged to individuals that had suffered testicular injury at an early period of life, by which the characters of youth were retained for a longer period than usual."

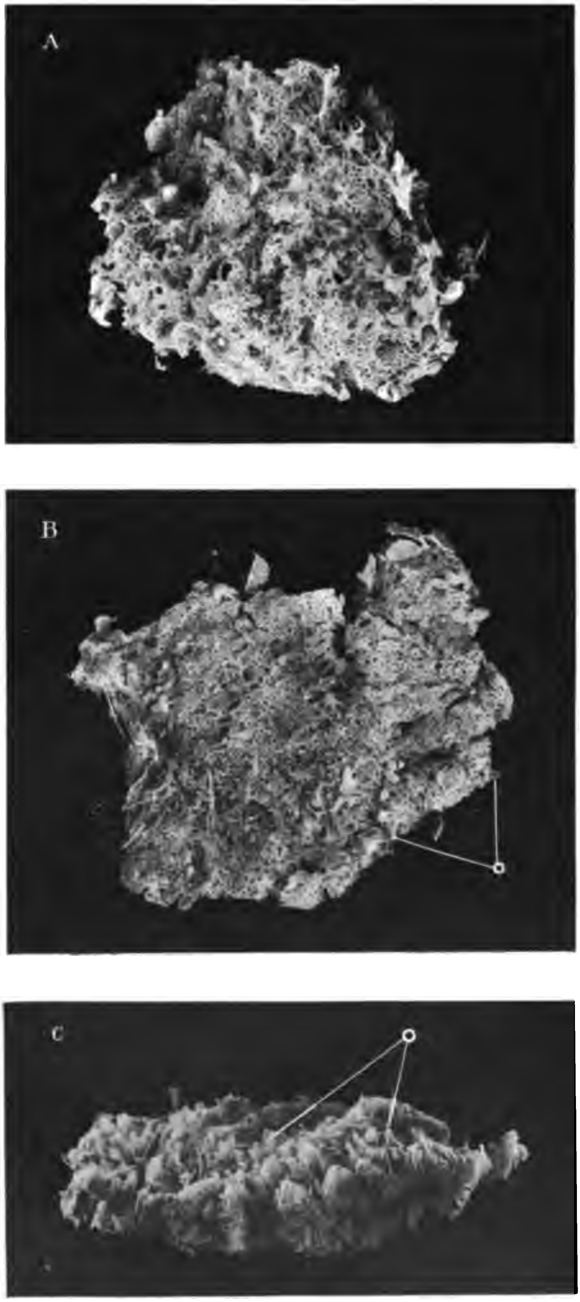
Mr. Holding pointed out from the specimens exhibited (text-fig. 1, p. 2) that the long pedicle, suppression of tines, and presence of rudimentary offshoots were characteristic of the antlers of all the *Cervidæ* at the first year or "pricket" stage, and were not therefore due to testicular injury, and that any interference or injury to the generative organs, as in castration, did

Text-fig. 1.



First-year antlers of certain species of Deer.

A, Red Deer; B, Wapiti Deer; C, Fallow Deer; and D, Roebuck—showing adventitious points marked × not being analogous to or the predecessors of the characteristic "tines" of the adult antler. E, lower portion of a pair of antlers of an aged Fallow buck, showing reappearance at the base of the left antler at × of one of these points or characters of the immature stage.



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CLATHRINA CONTORTA

not prolong or retain youthful characters of the antlers, but, quite the contrary, caused them to grow irregularly or had the effect of entire suppression of the antler.

He stated that very frequently an aged Stag or Fallow buck would throw up supernumerary snags at the base of the antler (text-fig. 1, E) or along the side of the beam, which somewhat resembled, and were probably a reversion to, these immature characters, and that there were several records of aged or barren hinds growing the simple "pricket" antlers of the first year.

Mr. R. I. Pocock, F.Z.S., exhibited and made remarks on a specimen of the Spanish Tarantula, *Lycosa hispanica*, that had died in the Society's Gardens.

On behalf of Mr. R. C. Punnett, F.Z.S., and himself, Mr. W. Bateson, F.R.S., F.Z.S., exhibited specimens of Fowls illustrating peculiarities in the heredity of white plumage, and made the following remarks:—

A *pure* white breed such as White Leghorn, crossed with a dark breed such as Brown Leghorn, gives a cross-breed substantially white, the colour being recessive. The White Rose-comb Bantam, however, crossed with a coloured breed gives coloured cross breeds, the white being recessive. But in every specimen examined carefully these recessive whites were found to have one or more minute ticks of black pigment. Though, superficially regarded, these ticked whites would be classified as white, experiment proves them to be entirely different in nature. These facts elucidate the paradoxical accounts given by Darwin and others that Black and White Bantams crossed together give both blacks and whites; for the black may fully dominate over the white in this particular case.

The following papers were read:—

1. On the Sponge *Leucosolenia contorta* Bowerbank, *Ascandra contorta* Haeckel, and *Ascetta spinosa* Lendenfeld. By E. A. Minchin, F.Z.S., University College, London.

[Received March 16, 1905.]

(Plate I.* and Text-figures 2–6.)

The Calcareous Sponges have been a very unfortunate group, from the systematic point of view. From the time when Haeckel swept away all previous generic names, in order to found his so-called natural system, up to the present day, scarcely any two

* For explanation of the Plate, see p. 20.

authors have been in agreement as to the names to be employed for the genera or as regards the grouping of the species, especially in the more primitive and interesting section of the Calcarea Homocœla.

The characters, for instance, by which Breitfuss defines the genus *Leucosolenia* of Bowerbank (1864) are such as would exclude from it all, or nearly all, the species which I should refer to it, including, as I have shown elsewhere, even Bowerbank's type species of the genus, *L. botryoides*; while Lendenfeld has always consistently declined to make any use at all of the oldest generic name amongst the Ascons. In short, with the exception, perhaps, of the malarial parasites, there is probably no other group in the animal kingdom in which the nomenclature is in so confused a state as in the Homocœla. The species which forms the subject of the present memoir illustrates well the statement just made. It is a veritable comedy of errors that I have to set forth.

The name *Leucosolenia contorta* was given by Bowerbank in 1866 [1] to certain small sponges from the Channel Islands—Guernsey, and the Guliot Caves, Sark. It is not very clear, however, what Bowerbank considered the distinctive characters of his species, since his diagnosis would apply to almost any Ascon. He states that "the form of this sponge is so distinctly different from that of *L. botryoides* that .... it cannot well be mistaken for that species .... *L. contorta* always appears to consist of a mass of contorted inosculating fistulæ." Further, that "the external surface of *L. contorta* is also sparingly furnished with recumbent acerate spiculæ, mostly disposed in a longitudinal direction, and I have never observed like spiculæ on the surface of *L. botryoides*." He was a little doubtful if his sponge were not really identical with *Spongia complicata* Montagu (1816), but came to the conclusion that Montagu's figure of *complicata* was "really a very characteristic figure of *Spongia botryoides* of Ellis and Solander," and that therefore the name *complicata* was to be rejected. Finally, Bowerbank remarks that *contorta* and *coriacea* might be mistaken for each other in the dried condition, but that "the total absence of defensive spiculæ on the cloacal cavity of *L. coriacea*" (meaning apparently the gastral rays of the quadriradiates) readily distinguishes it.

If we put Bowerbank's description into more modern terms, it amounts to this—that *L. contorta* was characterised (1) by form and appearance (contorted inosculating tubes), (2) by the presence of triradiate, quadriradiate, and monaxon spicules. The term "equiangular" applied by him to the triradiate systems need not be taken into account, since he applies the same term to the sagittal spicules of *botryoides*. It is not necessary to point out that the characters given by Bowerbank are not sufficient to define a species of Ascon; and when it is seen that *botryoides* always has monaxon spicules, as I have shown elsewhere, and that *contorta* may frequently lack them; that the specimen of *botryoides* from which Bowerbank figured spicules (Brit. Spong. iii. pl. iii. figg. 3, 4)

was really a specimen of *variabilis*, while the specimen of *contorta* of which the spicules were figured (*l. c.* figg. 8, 9, 10) was really a specimen of *complicata*; and that amongst nine of Bowerbank's specimens examined by me I have found four distinct species confused together—to wit, *complicata*, *variabilis*, *coriacea*, and "*Ascetta spinosa* Lendenfeld": I think it is not necessary to say more in support of the statement that Bowerbank's species *contorta* was of absolutely no systematic value whatever, but represented merely an ill-defined jumble of different species.

In 1872 Haeckel, in his 'Kalkschwämme' [2], used Bowerbank's specific name *contorta* for a sponge which he described in detail. Haeckel pointed out quite rightly that the external characters of *contorta* as set forth by Bowerbank were no guide whatever to its identification, since a quite similar mode of growth characterises other Ascons. Haeckel therefore diagnosed *contorta* by details of its spiculation. The diagnosis given is incorrect in two points, namely, in stating that the monaxons possess a lance-head at their distal extremity, and that the gastral rays of the quadriradiates are "curved oralwards"; two statements that lead me to suspect that Haeckel's material of *contorta* was, like Bowerbank's, contaminated by admixture of *Leucosolenia complicata*. Haeckel, in his description, also affirmed, in his usual manner, definite characters in the spiculation without taking into consideration the variability which is so marked a feature of the sponge. It is a puzzle to me how Haeckel arrived at the definition which he gave of *Ascandra contorta*, since the specimens named and identified by him which I have seen do not agree with his description, and belong, indeed, to other species—a fact which easily explains any errors of description on his part. It is even more mysterious that Haeckel should have considered his *contorta* identical with Bowerbank's *contorta*, since, of Bowerbank's specimens examined by me, eight in all, not one agrees with Haeckel's diagnosis! These enigmas are not, however, of importance to the present enquiry. Taking Haeckel's description as it stands, and allowing for a certain margin of inaccuracy, I have been able without difficulty to refer to Haeckel's *Ascandra contorta* a sponge extremely abundant on the Mediterranean coasts of France, and occurring elsewhere also. As I have stated in a previous memoir, I consider that where previous writers leave us in doubt as to the characters of a species, Haeckel's description fixes the application of the name. I will proceed now to describe the sponge which I regard as the true *contorta*, and then to consider the synonymy and application of the name.

Ascandra contorta H. is a species which, for reasons stated elsewhere [4, &c.], I refer to the genus *Clathrina* Gray (1867). It has a closely reticulate mode of growth, equiangular triradiate systems, collar-cells with basal nucleus, and parenchymula larva; all these being characters which make up my diagnosis of the genus *Clathrina*.

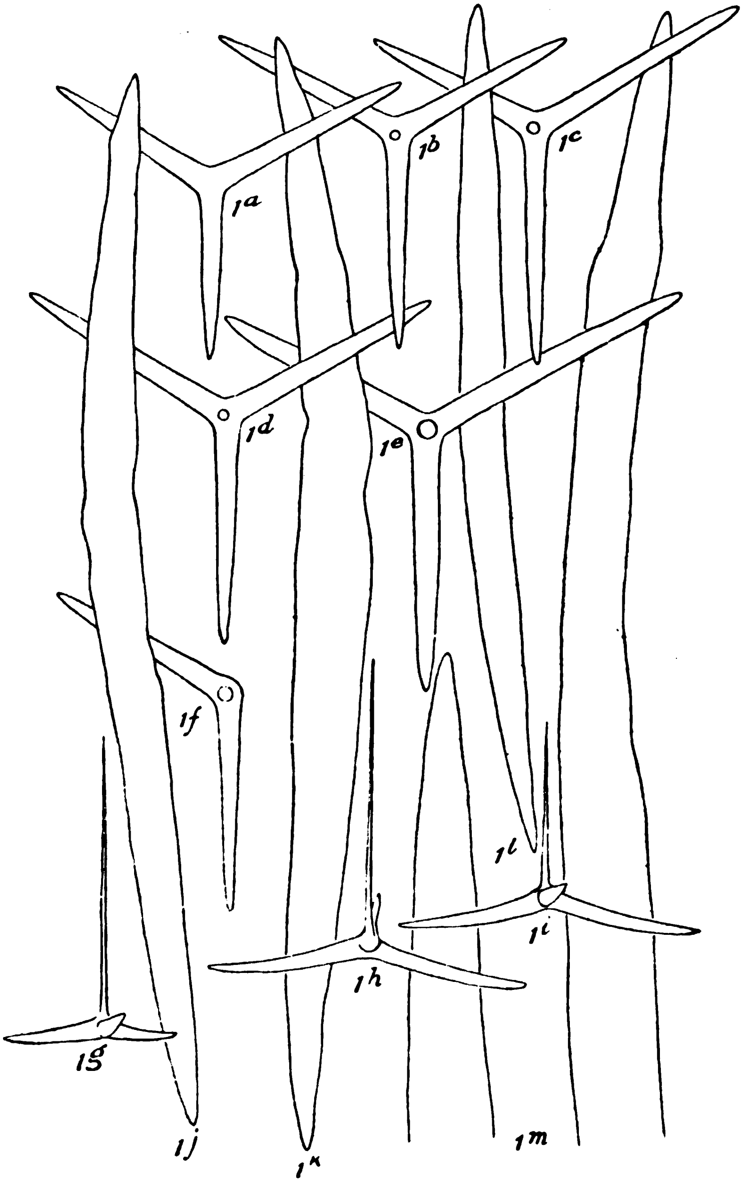
The specimens of this sponge which I have studied nearly all came from Banyuls-sur-Mer, where this species is extremely abundant. By the kindness of Monsieur Topsent, however, I have seen a specimen from Roscoff, not differing in any respect from the Mediterranean specimens. The sponge therefore has a wide range of distribution, and is almost certainly to be ranked as a member of the British Fauna, though it does not appear to be common on our coasts. Hanitsch has, indeed, recorded it from Liverpool: I have no reason to doubt the correctness of this record beyond the fact that my experience of specimens labelled *contorta* by the most eminent authorities has left me very sceptical as to the correctness of any identification of this species which I have not checked; a scepticism heightened, in the present instance, by the fact that Hanitsch names his specimens *Ascaltis contorta*. I may add that the sponges named *Ascandra contorta* by Breitfuss in various memoirs have nothing to do with this species, and should not therefore be taken into account in considering its geographical range.

At Banyuls-sur-Mer *Clathrina contorta* is not only one of the commonest, but also one of the largest Ascons occurring there. Colonies frequently measure 8 centimetres or more across. They consist of a massive or spreading growth of twisted anastomosing tubes, running in all planes, and forming a dense feltwork from which arise at intervals the short, straight, not very conspicuous oscular tubes, which reach two or three millimetres in height, and are of slightly larger calibre than the body-tubes, as the basal growth may be called. The body-tubes are centred round the oscular tubes more or less distinctly, and in the region of the oscular tube the basal system of tubes is usually slightly raised up to form a conulus bearing the oscular tube on its summit; but these conuli are generally very shallow, so that the upper surface of the spreading colony is nearly flat, not lobulated like that of *cerebrum*, nor cushion-like, as in *reticulum*—two species occurring commonly with *contorta*, but both very easily distinguished from it at sight. Photographs will make the external characters of *contorta* clearer than any description (Plate I.). Of its allies, it is perhaps *coriacea* with which *contorta* might be most easily confused, on simple inspection; the latter, however, with its greatly developed gastral rays, is not found contracted up, with closed oscula, like *coriacea*, and when expanded its body-wall is much thicker and less delicate.

The spiculation of *Clathrina contorta* comprises in typical specimens all the three kinds of spicules found in calcareous sponges.

The triradiate systems are equiangular, with the rays straight, tapering imperceptibly for the proximal half or two-thirds; after that tapering more rapidly to a sharp or moderately blunt point (text-fig. 2, 1 *a*–1 *f*). The distal extremities of the rays are often irregular in outline, sometimes markedly so. The rays vary in length from 80 to 130 μ in different specimens, but may be said to average 90–100 μ. The breadth at the proximal end of the

Text-fig. 2.



Spicules of a specimen of *Clathrina contorta* from Roscoff.

Figg. 1 *a*, triradiate; 1 *b*–1 *e*, quadriradiates in facial aspect; 1 *f*, abnormal quadriradiate with one basal ray wanting; 1 *g*–1 *i*, quadriradiates in side view, showing gastral rays in profile; 1 *j*–1 *m*, monaxons (the spicule represented by 1 *m*, being too long for the page, has been drawn in two pieces).

ray is usually 8 or 9 μ, but may reach 12 μ; speaking generally, slender triradiate systems, with rays not exceeding 10 μ in breadth, can be distinguished from thick ones with rays exceeding 10 μ (text-fig. 3, 2 *a*–2 *f*). In some specimens the triradiate systems are all, or nearly all, of the slender type; in others, triradiate systems of the thick type are more abundant.

Some of the triradiate systems develop gastral rays, becoming quadriradiates, and others do not. As a rule the quadriradiates are more abundant than the simple triradiates.

In some specimens there is a tendency for the simple triradiates to be of rather stouter build than the quadriradiates, but in other specimens this cannot be noticed.

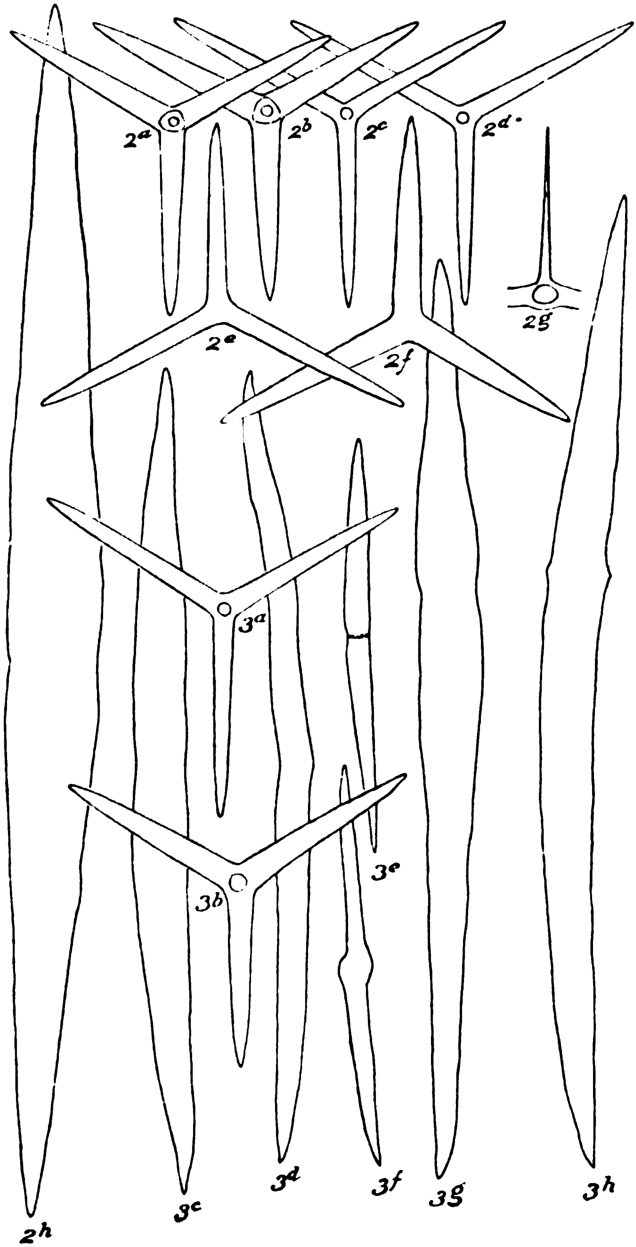
The gastral rays of the quadriradiates are attached at the centres of the triradiate system, and are remarkable for their slenderness and usually also for their length (text-fig. 2, 1 *g*–1 *i*). Arising from a slightly expanded base, the gastral ray sometimes tapers rapidly to a point, then reaching a length equal to about one-half or one-third of that of the basal rays; but more usually the gastral ray is prolonged to a considerably greater length than the basal rays, reaching 130 μ, 140 μ, or even 150 μ in length. The gastral ray then becomes excessively slender for the distal half or two-thirds of its length, and ends in a sharp point; it is not bent oralwards as Haeckel describes it, but it is either quite straight or irregularly curved. Haeckel's figure of a quadriradiate (Kalkschwämme, iii. pl. 14. fig. 6 *c*) obviously represents a spicule of *L. complicata* (compare his fig. 1 *e* on pl. 15, *l. c.*). Quadriradiates are also to be found in which, with gastral rays of great length, are found basal rays much shorter than usual text-fig. 2, 1 *g*; text-fig. 4, 4 *e*); these are probably young forms in which the rapid growth of the gastral ray * has caused it to attain its full length before the basal rays have done so.

In the thick quadriradiates found in many specimens, I have observed a curious point with regard to the gastral ray, when seen in the facial aspect of the spicule. When the basal system is focussed so that the bases of the rays show sharp contours, the origin of the gastral ray appears as a dark central spot roughly triangular in outline, each side of the triangle being transverse to the base of one of the rays of the triradiate system, and the angles of the triangle rounded off (text-fig. 3, 2 *a*, 2 *b*). If now the focus is slightly raised, the base of the gastral ray appears as a sharp ring, within the triangle. The dark triangle appears to be the expanded base of the gastral ray, but it is only to be seen in the case of the thickened triradiate systems, not in the slender ones.

The monaxon spicules of *Clathrina contorta* vary in the most singular manner, constituting the most remarkable feature of the species. The variations are best considered, first, from the point

* As I have described in a former memoir (Quart. Journ. Micr. Sci., n. s. xl. pl. 42. fig. 55), the elongated gastral rays of *contorta* are covered by a plasmodial mass containing four nuclei, more than I have observed on the gastral rays of any other Ascon.

Text-fig. 3.



Spicules of two specimens of *Clathrina contorta* from Banyuls.

Figg. 2 *a* & *b*, thick quadriradiates; 2 *c* & *d*, slender quadriradiates; 2 *e* & *f*, triradiates; 2 *g*, quadriradiate showing gastral ray in profile; 2 *h*, a monaxon. 3 *a* & *b*, quadriradiates of another specimen; 3 *c*–3 *h*, monaxons.

of view of substantive variations of form and size; secondly, as regards numerical variation, that is to say abundance of monaxons compared with other types of spicule.

The monaxons are all of large size, being at least twice as thick as the basal rays of the triradiate systems, and not less than 300 μ in length, allowing for those which are apparently not full-grown. But in some specimens the monaxons reach a size which can only be called gigantic. In a specimen from Banyuls sent me by Topsent (which I will refer to as Topsent 12 *e*), the monaxons, when drawn to the same scale as the other spicules figured here, come out 32 centimetres in length, corresponding to an actual length exceeding 1000 μ (1 mm.), with a breadth of about 50 μ at the thickest part. Even these proportions are exceeded by a specimen in my collection from Banyuls, in which the monaxons when drawn to scale measure 75 centimetres in length, corresponding to an actual length of 2343 μ (2·3 mm.). I do not think that spicules of such size have been recorded from any Ascon. The large monaxons of *Ascandra densa* and *A. parus* figured by Haeckel (*l. c.* pl. 14. figg. 2 *c*, 3 *f*) fall far below those that I have mentioned in dimensions. With these extraordinary variations in size, the form and characters of the monaxons are fairly constant (text-figg. 2 and 3, 1 *j*–1 *m*, 2 *h*, 3 *c*–3 *h*). They are spindle-shaped, pointed at both ends, slightly curved, sometimes distinctly so when more slender, or nearly straight when very thick. There is no lancet-head present at the distal extremity, as figured by Haeckel; his figure (*l. c.* pl. 14. figg. 6 *d*, 6 *e*) almost certainly refers to *complicata* (compare his figg. 1 *g*–1 *k*, on pl. 15). It is, indeed, impossible to say which is the distal end of these monaxons, as they do not project from the sponge like the true (primary) monaxons of other Ascons. Near the middle of the spicule, sometimes at about one-third of the length from one end, a slight constriction can be observed, sometimes very distinct, in others very shallow, in others again represented by an annular thickening, and sometimes not to be made out at all. This constriction is more distinct in young spicules, and appears to become more or less obliterated with growth. In big spicules the contours are often so sinuous and irregular that the primary constriction may be masked by secondary curves. I consider this primary constriction, as I propose to call it, of great morphological importance, as indicating probably that these spicules are not primary monaxons*, comparable to those of *Leucosolenia complicata*, for example, but in reality derived from a triradiate by loss of one ray and shifting of the two others into approximately the same straight line. In very young monaxons of *contorta* I have noticed a delicate transverse line in the region of the constriction (text-fig. 3, 3 *e*), and I have also found a spicule of which it would be difficult to affirm whether it is a young

* A primary monaxon is derived from a single mother cell which divides into two formative cells, thus originating in exactly the same manner as a single ray of a triradiate system.

monaxon or an abnormal triradiate (text-fig. 3, 3 *f*); probably it is both! My friend Mr. Alford has also found, in the slide of Topsent 12 *e*, four abnormal monaxons which have additional rays growing out laterally and thus become triradiates (text-fig. 6, 9 *a*–9 *c*). In one of these (9 *b*) the three rays are approximately equal in size and meet at the angles of an ordinary triradiate. For all these reasons I consider there is much to be said for regarding the monaxons of *contorta* as secondary monaxons derived from a triradiate system by suppression of one ray and hypertrophy of the two remaining, which become placed in the same straight line, or nearly so.

The numerical variation in the monaxons is not less remarkable. In some specimens scarcely any monaxons are to be found; in others they are extremely abundant. Thus in a specimen recently examined by me, I took a fairly large piece of the sponge, separated the spicules with Eau de Javelle, and mounted all I could get up with the pipette, covering three slides. After prolonged searching I found five monaxons to many thousands of triradiate systems. In another specimen in which I could find no monaxons, Mr. Alford by careful searching found two. It is often extremely difficult to be certain if a specimen has monaxons or not. Mr. Alford has kindly undertaken for me the task of counting the numbers of each kind of spicule found in different specimens, with the following results:—

Specimen.	Triradiates.		Quadriradiates.		Monaxons.		Kind of Monaxons observed.	Total of 3 kinds of Spicules.
	Actual number counted.	Percentage of whole.	Actual number counted.	Percentage of whole.	Actual number counted.	Percentage of whole.		
No. 1 (ζ 3 *a*–3 *h*).	93	3·278 +	2727	96·123 +	17	·599 +	Large.	2837
No. 2 (ζ 2 *a*–2 *h*).	311	8·304 +	3423	91·402	11	·294 +	Large.	3745
No. 3	386	12·512 +	2658	86·158 +	41	1·329 +	Very large.	3085
No. 4 (Plate I. B).	247	5·835 +	3965	93·668 +	21	·496 +	Very large.	4233
No. 5	146	5·144 +	2686	94·644 +	6	·211 +	Gigantic.	2838
No. 6 (Topsent 12 *e*).	267	10·349 +	2188	84·806 +	125	4·844	Gigantic.	2580
Total for Species.	1450	7·506	17647	91·35	221	1·144		19318

These results were obtained in the following way:—"Each specimen was put into Eau de Javelle to separate the spicules, and after careful washing, and being allowed to stand for some

considerable time after each washing, the spicules were transferred to the slides by means of a pipette.

"Each slide, when ready, then had marked upon its under surface twenty circular areas, each being brought into the microscopic field in turn and all spicules in each area carefully counted. When all the spicules were counted the circle was erased and the next circular area dealt with.

"The counting was done with the aid of a camera lucida and three differently coloured crayons, thus ensuring that all spicules were counted and counted once only.

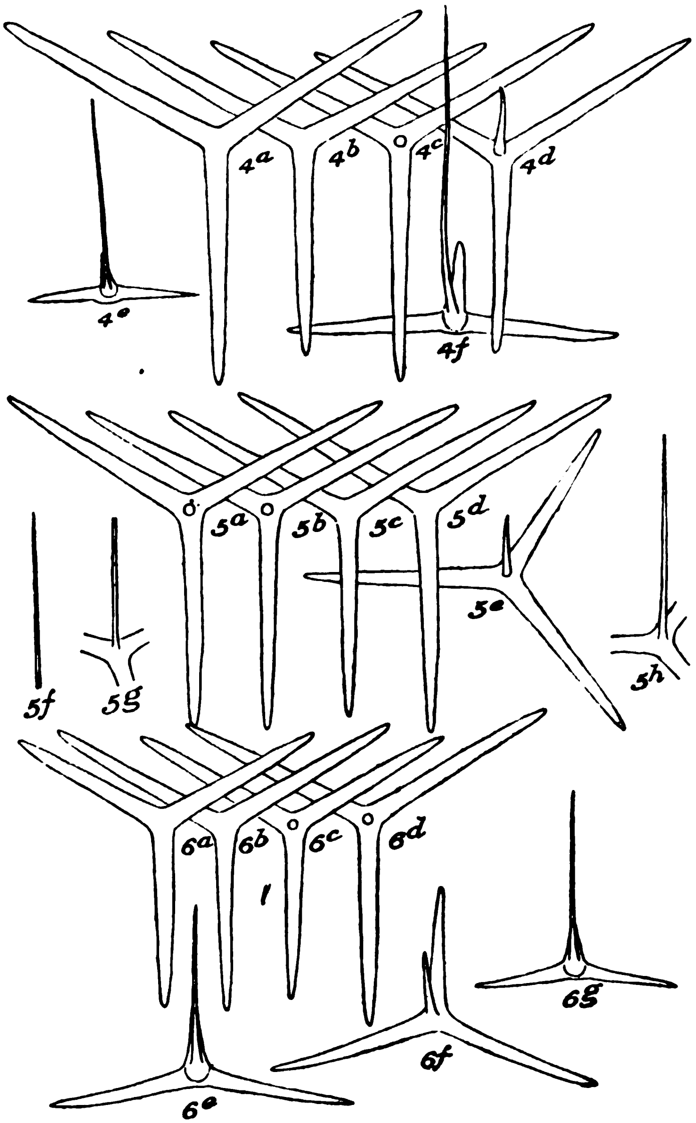
"Each quadriradiate spicule had a number in blue marked upon it; the triradiate spicules were marked with successive red numbers and a green number noted a monaxon. At each counting a check could be made, and the counting was complete when each spicule was seen to have one number of a special colour upon it."

The spiculation of *Clathrina contorta* thus shows, on the one hand, comparatively slight variation in the triradiate systems, and, on the other hand, extraordinary differences in number and size of the monaxons in different specimens. The variability is so marked, and the monaxons are frequently so difficult to find, as to suggest at once a possible extreme of variation in which the monaxons would be totally absent. Were this to occur we should have a variety of the sponge characterised by a type of spiculation which would lead to its being placed, in many current systems of classification, in a genus distinct from the variety in which monaxons occur.

As a matter of fact, I may state at once that the variety of *contorta* in which monaxons are completely lacking is very common, and it has been described by Lendenfeld from the Adriatic under the name of *Ascetta spinosa*. This is no mere surmise on my part; I have been able to examine, in the collection of Canon Norman, a slide obtained by him from Lendenfeld, and bearing in Lendenfeld's handwriting the label "*Ascetta spinosa.*" Text-fig. 4, 5 *a*–5 *h*, represents some spicules drawn by me from this slide. As will be seen, the spiculation differs in no single particular from that of the true *contorta*, except for the lack of monaxons. Since the preparation consists of tubes of the sponge mounted whole, it was not possible to obtain profile views of the gastral rays, except at the torn ends of the tubes, and in no case was I able to see an unbroken gastral ray in side view, but the fragments which I have drawn (5 *f*–5 *h*) are sufficient to prove that the gastral rays of this specimen attain the degree of length and slenderness characteristic of the species. Lendenfeld's specimen is, in fact, identical in character with other specimens of "*spinosa*" which I have from Banyuls (text-fig. 4, 6 *a*–6 *g*), and these again differ in no respect from the true *contorta* except for the absence of monaxon spicules.

If *Ascetta spinosa* Lend. is to be regarded, as I believe, merely as a variety of *Ascandra contorta* H., how is this variation to be explained? The specimens of *spinosa* that have come under my notice agree perfectly in external characters with *contorta*, but are

Text-fig. 4.



Spicules of the "*spinosa*" variety of *Clathrina contorta*.

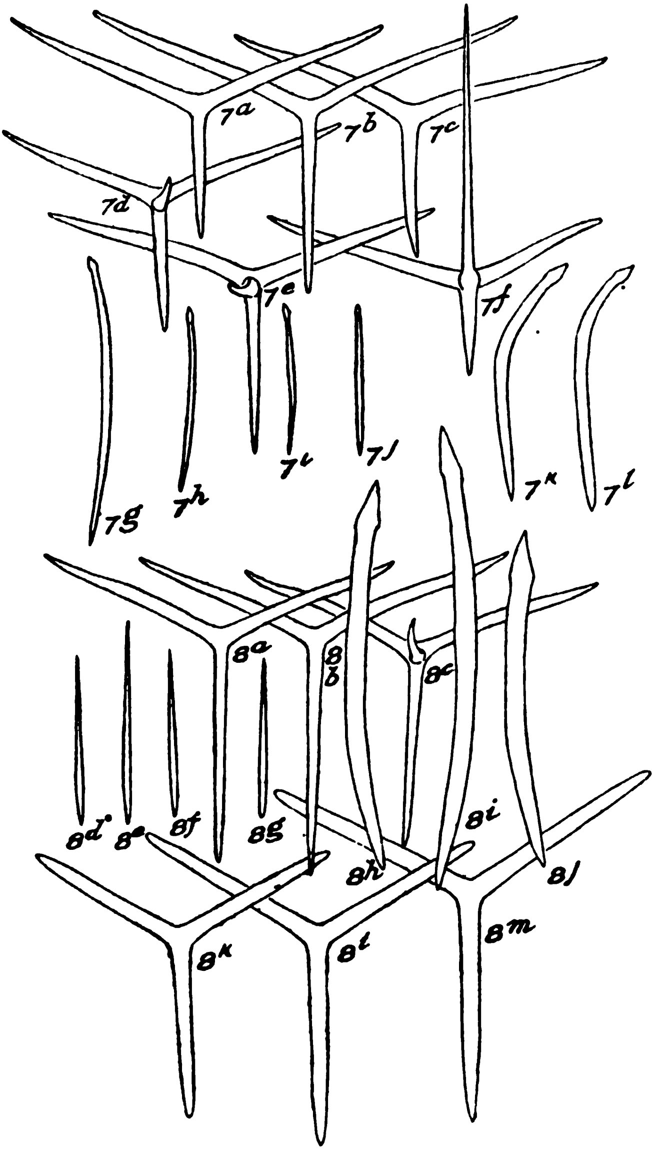
Figg. 4*a*–4*f*. Spicules of Bowerbank's type of *Leucosolenia contorta* in the British Museum (Bowerbank Coll. 988), showing gastral rays with tendency to irregular curvature.—Figg. 5*a*–5*h*. Spicules of a specimen in Canon Norman's collection labelled "*Ascetta spinosa*" in Lendenfeld's handwriting; the elongated gastral rays (5*f*–5*h*) are broken off.—Figg. 6*a*–6*g*. Spicules of a specimen from Banyuls.

all of small size. The big, spreading colonies of *contorta* always have monaxons. It is my belief that the absence of monaxons is simply a juvenile feature, so to speak, of the sponge, and that they are only formed when the sponge has grown to a certain size. Such changes of spiculation with age are probably more frequent in sponges than is usually supposed. For a parallel case I need only refer to Topsent's observations on *Cliona celata*.

A point which requires brief discussion, however, is why Lendenfeld found only the *spinosa*-form in the Adriatic, and not the *contorta*-form, if these two forms are really only age-variations in one species. Are we to suppose that in the Adriatic the sponge does not acquire monaxons? In my opinion the explanation of this point is to be sought in quite a different manner. In his 'Kalkschwämme der Adria' [3] Lendenfeld describes another species of *Clathrina* occurring commonly in the Adriatic, namely *C. reticulum*. I have also found this species very abundant at Banyuls, and I possess many specimens of it; but my experience of this species at Banyuls differs sharply in one respect from Lendenfeld's observations upon it in the Adriatic. I find *reticulum* to be more constant in external form and characters than any other species of *Ascon*. All the specimens I have seen—and at one time I had some hundreds of specimens, collected in order to obtain the larval development—are compact, rounded, cushion-like masses of slender, closely-knit tubes, forming a dense and finely-meshed reticulum from which arise one or more oscular tubes of much larger calibre than the tubes forming the body of the sponge. I have figured such a specimen elsewhere (**4**, p. 6, fig. 6). In short I have never had the slightest difficulty in recognising *reticulum* at sight, though its spiculation often approaches that of *contorta* very closely. My astonishment was therefore great to find that Lendenfeld describes this sponge as occurring (at Sebenica and Lessina) in nearly all the forms generally found in Ascons. There is thus a great discrepancy between Lendenfeld's observations and mine with regard to this species, and I am inclined to think that this is to be explained simply by Lendenfeld not having recognised the true *contorta*, but having confused it with *reticulum*. This is a supposition which I am unable to prove or test; but if correct, it would explain why Lendenfeld did not find the true *contorta* occurring in the Adriatic as well as *spinosa*, and also why he finds *reticulum* so variable in form when in my experience it is so extremely constant. I may add, finally, that the figures of monaxons of *reticulum* given by Lendenfeld (**3**, pl. viii. figg. 7 *e*–7 *f*) are more like those of *contorta* than those of *reticulum*, though not exactly like those of either, as these sponges are known to me.

I will now describe some of the historically important specimens to which I have had access, and I begin with the type-specimens of Bowerbank's *Leucosolenia contorta* in the British Museum (Bowerbank Coll. 988). The "type" consists of seven dried specimens, all very small, stuck on a card. The largest specimen,

Text-fig. 5.



Spicules of *Leucosolenia*, *Sycon*, and *Clathrina*.

Figg. 7 *a*–7 *l*. Spicules of a specimen in Norman's collection, received from Bowerbank with label *Leucosolenia contorta* and identified by Haeckel as *Ascandra contorta*; showing spicules of *Leucosolenia variabilis* (7 *a*–7 *j*), mixed with spicules of *Sycon* sp. (7 *k*, 7 *l*).—Figg. 8 *a*–8 *m*. Spicules of a specimen in Norman's collection received from Bowerbank with label *Leucosolenia contorta*; showing spicules of *Leucosolenia complicata* (8 *a*–8 *j*) mixed with spicules of *Clathrina coriacea* (8 *k*–8 *m*).

the original of Bowerbank's fig. 7 on pl. iii. of Brit. Spong. vol. iii., is at the top over the middle of the card; the other six are in two vertical rows of three each to right and left. As I have stated elsewhere, I have examined six out of these seven specimens, and all of them, except the larger one at the top, are quite typical specimens of *Leucosolenia complicata*; the large specimen alone is a true *Clathrina*. I give figures of its spicules (text-fig. 4, 4 *a*–4 *f*), and it is not necessary for me to describe them in detail, for it is evident from the figures that this specimen agrees with the true *contorta* in all respects but one, namely, in that the monaxons are wanting. In short, Bowerbank's type-specimen of "*Leucosolenia contorta*," or, to be more accurate, the only one of his type-specimens which does not belong to a species of prior standing, is a specimen of "*Ascetta spinosa*" Lendenfeld!

I have also examined two other specimens of Bowerbank's *, given by him to Canon A. M. Norman, and now in the latter gentleman's collection. The first of these was sent by Canon Norman to Haeckel, and returned by him after examination. It has the following label in Norman's handwriting:—

"*Leucosolenia contorta* Bow.
"Guernsey
"(A type-specimen from Dr. Bowerbank)."

Also a label in Haeckel's handwriting:—

"*Ascandra contorta* H.
"(*Leucosolenia contorta* Bwbk.)
"Guernsey, Bowerbank."

If any specimen in the world ought to have been a specimen of *contorta*, surely this ought, bearing, as it does, a double testimonial to character from the two founders of the species. What, then, was my astonishment, on examining the spicules, to find it a quite typical example of *Leucosolenia variabilis* Haeckel! I figure its spicules in text-fig. 5, 7 *a*–7 *l*. The only point to notice about them is a certain admixture of *Sycon* spicules (7 *k*, 7 *l*), which, as I have set forth in another place, frequently occurs in preparations of *variabilis*.

The second specimen in Canon Norman's collection bears a label in Bowerbank's handwriting as follows:—

"*Leucosolenia contorta*, Guernsey."

According to information furnished me by Canon Norman, this particular specimen was not sent to Haeckel, but it is one of the same lot as the type sent to him, and has an equal claim to be regarded as a type. Examination of the specimen shows a mixture of *Leucosolenia complicata* and *Clathrina coriacea* (text-fig. 5, 8 *a*–8 *m*).

* Bowerbank in his Monograph mentions twenty-eight specimens of *contorta*, but I have had access to only nine of them. I do not know what has become of the others.

From the foregoing it will be seen, I think, that the name-question, in the case of the species under consideration, is a tangled problem, one, indeed, which I feel some diffidence in approaching. I could wish, in fact, as I have said elsewhere, that there were in existence some sort of International Hague Tribunal to which these knotty points of nomenclature could be referred for arbitration and authoritative settlement. In the absence, however, of any such body, I extract from the facts above set forth the following conclusions:—

(1) Bowerbank's *Leucosolenia contorta* was a jumble of different species, and his description could not be used for identification of any particular species. Hence *Leucosolenia contorta* Bowerbank is a *nomen nudum*, of no systematic validity.

(2) Haeckel's *Ascandra contorta*, though not in all respects correctly described, can be applied to an existing species of Ascon, which can be identified by his description. This I consider the true *contorta*: ought the species, however, to be written *contorta* Bwk. or *contorta* H.? Pending the constitution of the International Nomenclature Tribunal, in order to settle this important point, I content myself in following Haeckel in calling it *contorta* Bwk.

(3) *Ascetta spinosa* Lend. is probably the young form, without monaxons, of *contorta*.

I arrive therefore at the following synonymy and diagnosis:—

Clathrina contorta (Bowerbank).

? *Nardoa spongiosa* Kölliker *, 1864, Icones Histologicæ, Abth. i. pp. 63, 64, pl. vii. fig. 10, pl. ix. figg. 6–8.

Leucosolenia contorta Bowerbank 1866, Mon. Brit. Spong. ii. pp. 29–32; 1874, op. cit. iii. pp. 7–8, pl. iii. figg. 5–10.

Leucosolenia (*Nardoa*) *contorta* Gray, 1867, P. Z. S. p. 555.

Leucosolenia (*Leuciria*) *contorta* Haeckel, 1870, Jen. Zeitschr. v. p. 243.

Ascandra contorta Haeckel, 1872, Kalkschwämme, ii. pp. 91–93, iii. pl. 14. figg. 6 *a*–6 *e*.

? *Ascaltis contorta* Hanitsch, 1890, Tr. Biol. Soc. L'pool, iv. pp. 195 & 233.

Ascetta spinosa Lendenfeld, 1891, Zeitschr. wiss. Zool. liii. pp. 203–205, pl. viii. figg. 2, 16, 21, 22.

Leucosolenia contorta Topsent, 1891, Arch. Zool. Exp. (2) ix. p. 525; Bull. Soc. Zool. France, xvi. p. 128; 1892, Résult. Campagnes Sci. Albert 1er, fasc. ii. p. 22; 1894, Rev. Biol. Nord France, vii. pp. 7 & 22.

Clathrina contorta Minchin, 1896, Ann. & Mag. Nat. Hist. (6) xviii. p. 359.

* *Nardoa spongiosa* Kölliker has been put by Haeckel as a synonym of either *Ascaltis cerebrum* or *A. gegenbauri*, but the figures of the external form, no less than those of the spiculation, given by Kölliker, seem to me to indicate that the author was dealing with the *spinosa*-form of *contorta*. I have discussed this point elsewhere (Quart. Journ. Micr. Sci. n. s. xl. p. 533, footnote).

Clathrina spinosa Minchin, ibid.

Leucosolenia spinosa Breitfuss, 1898, Arch. f. Naturges. lxiii. 1, p. 213.

(The following references, on the other hand, probably do not relate to the true *contorta*.)

Ascandra contorta Barrois, 1876, Ann. Sci. Nat. (6) iii. Article 11, p. 35, probably refers to *Leucosolenia complicata*.

Leucosolenia contorta Carter, 1880, Midland Naturalist, ii. p. 195. The author remarks that "Bowerbank's illustration of the linear spicule is defective. There are *two* forms, quite different from each other and from Dr. Bowerbank's figure." I consider it probable from this statement that Carter was dealing with a specimen of *Leucosolenia complicata*.

Ascandra contorta Breitfuss, 1898, Arch. f. Naturges, lxiii. 1, p. 214, refers to a specimen of *Leucosolenia complicata*; so probably also the sponge described and figured by the same author in Mém. Ac. St. Pétersbourg, 1898 (viii.) vi. p. 15, pl. i. fig. 1, and cited by him in other memoirs.

And finally it should be mentioned that the numerous specimens sent out from Sinel and Hornell's Zoological Station, Jersey, are all, so far as I have seen, specimens of *Leucosolenia complicata*.

Diagnosis.—Triradiate systems equiangular, with or without gastral rays; the quadriradiates generally more numerous than the simple triradiates. Rays of the triradiate systems tapering imperceptibly for the proximal half or two-thirds, then narrowing more rapidly to a sharp or moderately blunt point. Gastral rays sometimes short, more usually longer than the basal rays, very slender, sharp, and straight or irregularly curved.

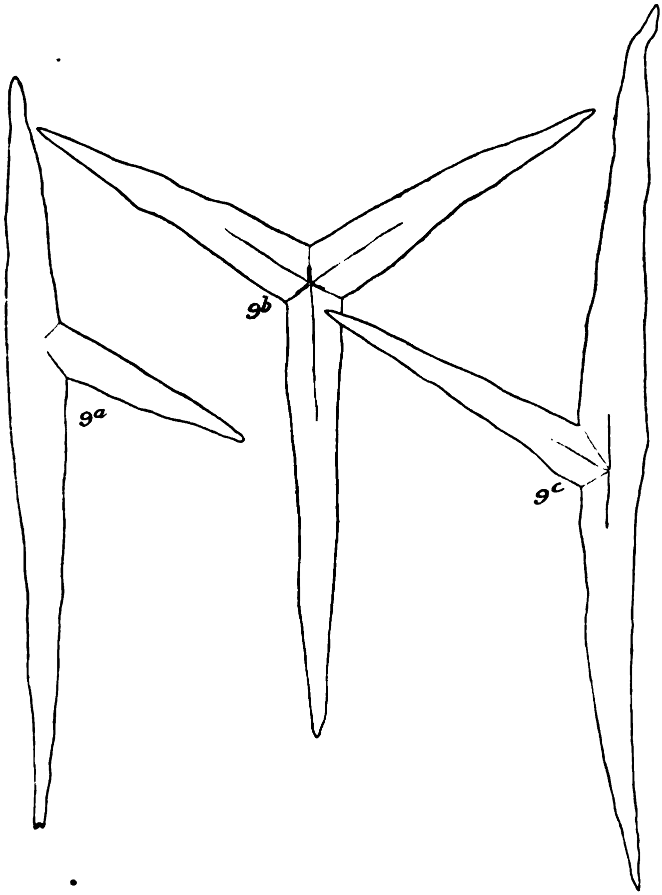
Monaxons at least twice as thick as the basal rays of the triradiate systems,—varying in different specimens from a moderate size to gigantic proportions, spindle-shaped, usually slightly curved, and usually with a distinct constriction near the middle of their length; sometimes very few in number, sometimes absent altogether.

The chief objection that can be made, it seems to me, with regard to my treatment of the species, relates to the position of *spinosa*. Naturalists concerned chiefly with the arrangement of specimens in bottles on shelves will perhaps object to my "lumping" together two forms which can be separated by a definite character, although by one only. Those who reason thus will, no doubt, prefer to retain *spinosa* as a "species" distinct from *contorta*; in that case the type of Bowerbank's *contorta* belongs to the former species, a fact which raises alarming problems of nomenclature. The range of variation seen in *contorta* has its natural and logical termination in the form *spinosa*, and justifies, in my opinion, placing the latter as a synonym. Moreover it is often extremely difficult to be certain that monaxons are really absent in a specimen of "*spinosa*." They may be so scarce that they have been simply overlooked.

After arriving at the above conclusions with regard to the

identity of *contorta* and *spinosa*, it is hardly necessary for me to express my opinion with regard to those systems of classification which define not only species but even genera of Ascons by the presence or absence of monaxon spicules. Before such a character as the presence or absence of monaxons can be used for systematic

Text-fig. 6.



Abnormal gigantic spicules of the class of the monaxons from a specimen of *Clathrina contorta* from Banyuls (Topsent 12 *e*). Magnified about 150 linear (*i. e.* half as much as the spicules figured in text-figg. 2–5).

purposes, it is necessary to understand clearly what is meant by a monaxon spicule. In calcareous sponges a spicule of this class may be one of two perfectly distinct things. It may be, on the one hand,

a primary monaxon spicule, derived from a single mother-cell, and developing exactly in the same way as a single ray in a triradiate system, with which it is strictly homologous. It may be, on the other hand, a secondary monaxon, derived by modification of an entire triradiate system by loss of one ray, perhaps in some cases two rays. Good examples of monaxons undoubtedly of secondary nature are the elbowed monaxons in the stalk of *Clathrina lacunosa* Johnston (renamed *Ascandra angulata* by Lendenfeld). I believe also, as stated above, that the monaxons of *contorta* are to be regarded as secondary. It is clear that a character which is sometimes one thing, in other cases quite another thing, cannot be usefully employed for purposes of systematic classification, not, at least, until more is known about it.

If *Ascetta spinosa* be put as a synonym of *Clathrina contorta*, it is seen that the species has a wide range, extending from the Adriatic round the coasts of France into the English Channel, and probably also on to the coasts of Great Britain.

It is my pleasant duty finally to express my thanks to friends who have assisted me in the preparation of this memoir, put together from observations for the most part of long standing, at a time when the stress of other work, caused by preparations for my departure for the Tropics, was very great. My friend Mr. G. R. Alford, who is making a special study of the variation of this sponge, has given me valuable assistance, as will be evident from the facts I have quoted from him above. Mr. Alford has also kindly undertaken to see this memoir through the press for me. My friend and pupil Mr. L. R. Crawshay has given me great help in preparing the illustrations. Finally, I have to thank Monsieur Topsent, of Caen, for his kindness in sending me specimens from Roscoff and elsewhere and for answering many queries.

Bibliography.

(1) Bowerbank, J. S. A Monograph of the British Spongiadæ. London, Ray Society, 3 vols.: 1864–1874.

(2) Haeckel, E. Die Kalkschwämme. Berlin, 1872; 3 vols.

(3) Lendenfeld, R. v. Die Spongia der Adria: I. Die Kalkschwämme. Zeitschr. wiss. Zool. liii. (1891) pp. 185–321, 361–433, pls. viii.–xv.

(4) Minchin. E. A. Sponges in: Lankester, 'A Treatise on Zoology,' London, 1900.

Other references are cited in the list of synonymy, p. 17 above.

EXPLANATION OF PLATE I.

Clathrina contorta from Banyuls.

A from above; B from above, and C from the side, to show the oscular tubes (O).

2. Some Notes upon the Anatomy of the Ferret-Badger, *Helictis personata*. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received March 21, 1905.]

(Text-figures 7–12.)

The dissection of a female example of *Helictis personata*, which was acquired by the Society on the 4th and died on the 14th November, 1904, enables me to lay before the Society some new facts in the anatomy of this genus of Carnivora.

So far as I am aware, the only zoologist who has investigated the anatomy of the soft parts of the genus *Helictis* is the late Prof. Garrod *, whose memoir deals with the essentials in its structure. The species examined by him was *Helictis subaurantiaca*. It is not therefore unnecessary to report upon the anatomy of another species, though the differences between the two are, as might be expected, but slight. I deal, moreover, with a few points upon which Prof. Garrod did not touch in his account.

§ *Brain.*

The brain of *Helictis subaurantiaca* has been described and figured (in dorsal and lateral view) by Prof. Garrod in his memoir already referred to †. The figure of the brain of *Helictis personata* submitted herewith (text-fig. 7, p. 22) shows certain differences, which I regard as worthy of record in view of the little knowledge which we possess upon the matter.

The most salient difference which this brain shows from that of *H. subaurantiaca* is the very slight appearance upon the dorsal surface of the intercalary prolongation of the calcarine sulcus. This furrow, as will be seen in the figure (text-fig. 7), only appears dorsally for a short distance quite at the posterior end of the hemispheres, and also of course anteriorly where the two sulci join the crucial sulci.

The precrucial sulcus in my specimen is not so fully developed, particularly upon the left side (text-fig. 7, *Pc.S.*), as in Garrod's specimen of *Helictis subaurantiaca*. It does not entirely delimit the ursine lozenge in front.

The Sylvian fissure on both sides of the brain joins the suprasylvian, the gyrus anterior to the Sylvian being apparently depressed below the surface of the hemispheres. There is a hint of this in Garrod's figure, but hardly in that of Dr. Elliot Smith, though it refers, I imagine, to the same brain. The remaining fissures agree absolutely with those of *Helictis subaurantiaca*. I pass on therefore

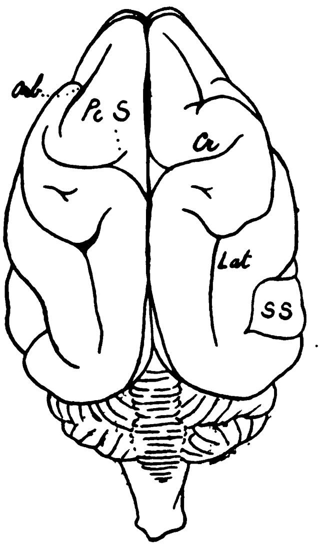
* "Notes on the Anatomy of *Helictis subaurantiaca*," P. Z. S. 1879, p. 305.

† This brain is also figured in the Catalogue Physiol. Series Roy. Coll. Surgeons, vol. ii. (2nd ed.) p. 273, by Dr. Elliot Smith.

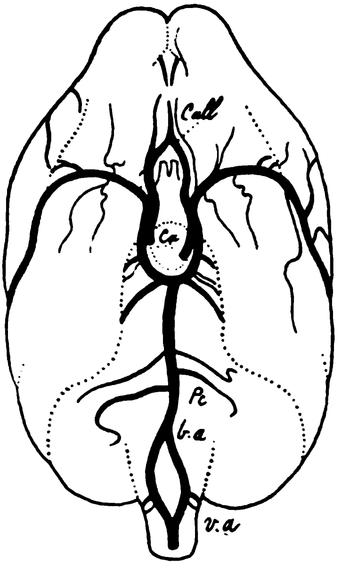
to the arteries of the brain, which are most satisfactorily injected in my specimen and which show all the Arctoid characters*. The rhomboidal area formed by the bifurcation of the anterior spinal and its junction with the basilar is of considerable calibre and uniform throughout, as in all Carnivora which have been examined.

The vertebral arteries are, however, peculiar in their mode of joining this rhomboidal vessel. Each vertebral artery in fact divides before joining the rhomboidal, and each branch opens separately into it, as is shown in the accompanying figure (text-fig. 8). The carotids join the circle of Willis just before the middle cerebral arteries are given off.

Text-fig. 7.



Text-fig. 8.



Text-fig. 7.—Brain of *Helictis personata*, dorsal aspect.

Cr. Crucial fissure; *Lat.* Lateral fissure; *Orb.* Orbital fissure; *Pc.S.* Precrucial fissure; *S.S.* Supra-Sylvian fissure.

Text-fig. 8.—Brain of *Helictis personata*, ventral aspect, with the arterial system shown in thicker and thinner black lines. The dotted lines delimit regions of the brain.

b.a. Basilar artery; *Ca.* Carotids; *Call.* Callosal arteries; *P.c.* Posterior cerebellar; *v.a.* Vertebral arteries.

Anteriorly the circle of Willis is completed by the fusion of the two callosal arteries, that of the right side being distinctly smaller than that of the left.

* Beddard, P. Z. S. 1904, vol. i. p. 183.

The posterior cerebellar arteries are asymmetrical in their origin from the basilar, the left being considerably in front of the right.

The middle cerebellar arteries arise in front of the sixth nerve.

§ *Some Notes on the Muscles.*

The muscular anatomy of the Carnivora has been lately treated of in an exhaustive fashion by Messrs. Windle and Parsons*. As a supplement to that paper (which does not deal with *Helictis*) I am able to offer a few notes upon the musculature of *Helictis personata*.

The *Sterno-mastoid* consists from the very beginning of two parts: the larger of these is inserted on to the mastoid next and superficial to the cleido-mastoid muscle; the smaller part crosses the cleido-mastoid and joins the cephalo-humeral. This latter portion of the muscle has been spoken of as a portion of the trapezius, with which, indeed, it is plainly confluent above.

The *Sterno-hyoid* and *Sterno-thyroid* appear to arise from the sternum as one muscle. I could find no tendinous intersection.

The *Omohyoid* is apparently completely absent. I could find no trace of it. This muscle is usually present in Mustelidæ.

The *Omotrachelian* has exactly the relations described by Windle and Parsons.

The *Rhomboideus profundus*, which arises from the supra-spinous fossa of the scapula near to the root of the spine, is a slender muscle inserted on to the atlas deep of the omotracheal. It is perfectly distinct at its origin from the *Rhomboideus cervicalis*. Its discovery in *Helictis* gives further support to Messrs. Windle and Parson's belief that the muscle is eminently characteristic of the Mustelidæ.

The *Rhomboideus capitis* has only a single origin in common with the *Rhomboideus cervicalis*, not the double origin of *Ictonyx* (a near ally of *Helictis*) as figured by Windle and Parsons.

The *Dorso-epitrochlear* is contiguous to and hardly if at all distinguishable from the extra head of the *Triceps* occurring in this as in many other Carnivora. The *Dorso-epitrochlear* itself is of course part of the *Latissimus dorsi*; in passing by the scapula it receives a mass of fibres from the lower border of that bone and thence becomes continuous with a sheet of fibres arising from the *Teres* and constituting, as I imagine, the "extra head" of the *Triceps* of Messrs. Windle and Parsons, which those anatomists state to be characteristic of the Mustelidæ.

The *Biceps* has only one head.

Helictis appears to possess two distinct *Palmaris longus* muscles.

The *Sartorius* is single and fused at its insertion with the also single *Gracilis*.

The *Pectineus*, often a double muscle, is single in *Helictis*.

* P. Z. S. 1897, p. 370, & 1898, p. 152.

I found it impossible to subdivide the *Adductor* mass.

The *Semimembranosus* is divided into two muscles for some way in front of its obviously double insertion on to the tibia and the femur. I could not find, however, that this muscle was divided at its origin from the ischium.

The *Semitendinosus*, as in some other, but not in all, Mustelidæ, has a very distinct caudal head. There is no *Agitator caudæ*.

The *Tenuissimus* is plainly present.

The *Tibialis anticus* is single.

§ *Lungs.*

As Prof. Garrod pointed out in *H. subaurantiaca*, the lungs in *H. personata* consist of four lobes on the right side and two on the left. Prof. Garrod, however, made no observations upon the relative sizes of the several lobes. On the right side the first lobe is rather larger than the second; the third is the biggest of all and quite twice the size of the first; the fourth or azygos lobe is the smallest of all.

The two lobes on the left side are more nearly equal in size, but the second or lower lobe is the larger.

§ *Liver.*

The liver of this species appears to be much like that of *H. subaurantiaca*. The enormous right central lobe is deeply* fissured and exposes the gall-bladder on the diaphragmatic side. This lobe is quite twice the size of the left lateral lobe, which is the next largest; this lobe again is larger than the right lateral, which does not show any great difference of size from either the left central or the caudate. The Spigelian lobe is minute.

§ *Pancreas.*

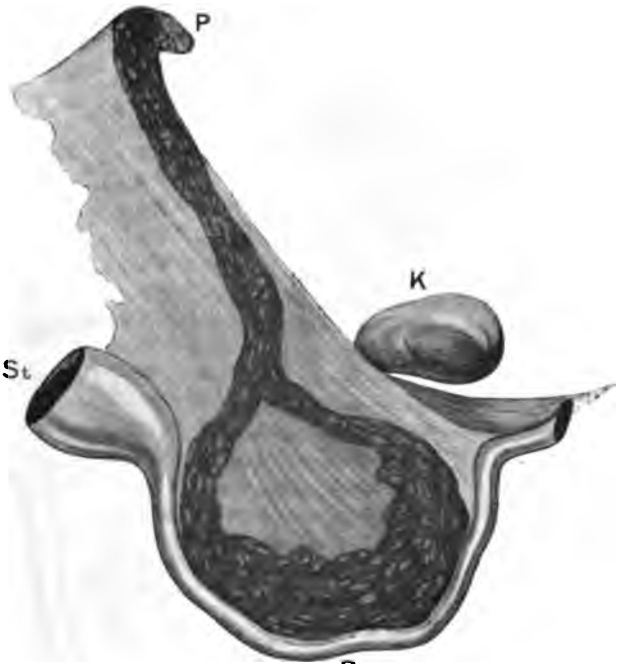
The pancreas of *Helictis* is almost exactly like that of the Tayra (*Galictis*), with which Arctoid I have specially compared it. It is not clear from Garrod's description what is the precise form of the gland in the species investigated by himself. In *H. personata* there is a circular portion of the pancreas running right round the duodenal loop †; this ends in a straight piece running parallel with the spleen. The chief difference which *Helictis* shows from *Galictis* is in the mesenterial attachment of the straight part of the pancreas. In *Galictis* a transparent mesentery, apparently anangious, is attached to the whole length of the straight region of the pancreas, and is inserted on to the mesocolon along a line which commences in front of and ends behind the left kidney.

* But not quite so deeply as in *Galictis*.

† As in many Carnivora, cf. *e. g.* Owen's Comp. Anat. vol. iii. p. 496.

In *Helictis*, on the other hand, this membrane is of much less extent. It is only attached to about half the length of the pancreas and is inserted on to the mesocolon along a line which begins a little before the left kidney but ends at about its middle. This characteristic difference is illustrated in the figures (text-figs. 9, 10).

Text-fig. 9.



Pancreas and adjacent regions in *Helictis personata*.

D. Duodenum; *P.* End of pancreas; *K.* Kidney; *St.* Stomach.

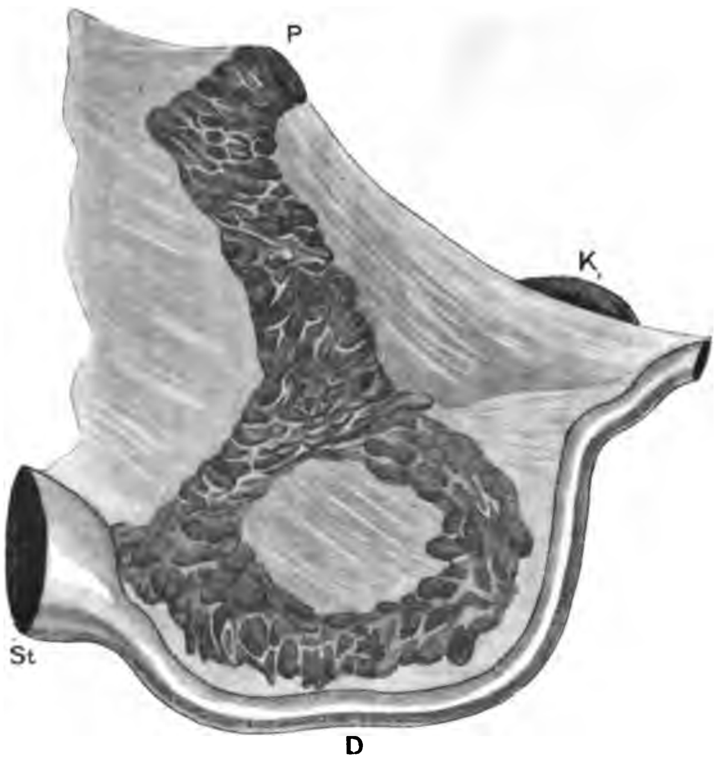
§ *Ovary and Broad Ligament.*

As is very frequently, if not constantly, the case with the Arctoidea, the ovary is completely encapsuled and thus continuous, anatomically, with the Fallopian tube.

An interesting point concerns the suspension of the ovary and oviducal canal. The mesoarium is continued forwards for a short distance in front of the ovary, running attached to the parietes to the outside of the kidney. In *Galictis* there is the same forward prolongation of this fold, which has the same position in relation to the kidney, but it extends much further forward on

both sides, in fact nearly to the diaphragm. In *Cynictis levaillanti* and *Arctictis binturong*, which I examined for purposes of comparison, the conditions are a little different. In the former the fold of peritoneum in question runs *over* the kidney instead of avoiding it, and ends on the parietes a little way in front and outside of that gland. In the Binturong the mesoarium on the right side extends nearly up to the diaphragm, passing over the

Text-fig. 10.



Pancreas and adjacent region in *Galictis barbara*.

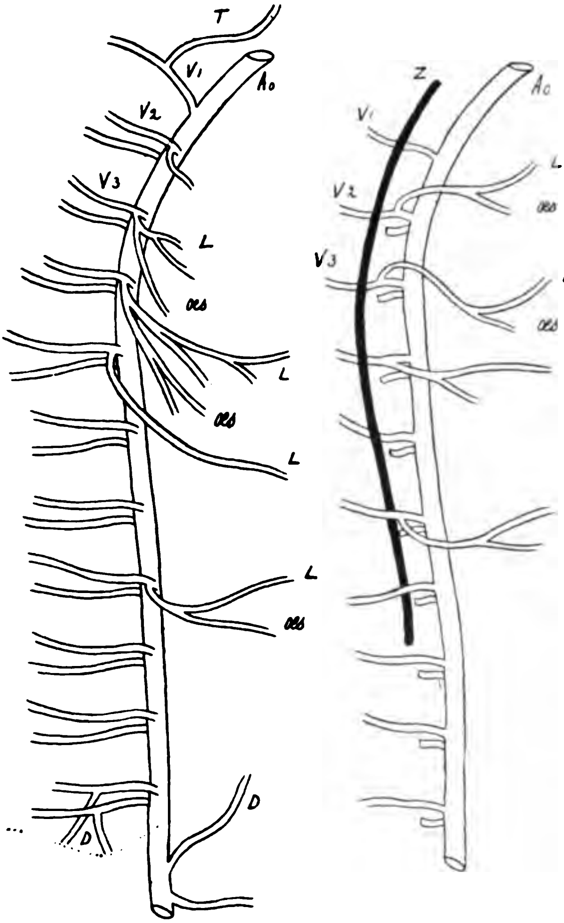
Lettering as in text-fig. 9.

kidney and being naturally attached to it on its passage. On the left side, this fold of peritoneum actually reaches the diaphragm, passing also over the kidney of its side. I will not assert at present that there are here characters which serve to differentiate the Arctoid from the Æluroid Carnivora, but they do as a matter of fact differentiate certain Æluroids from certain Arctoids.

§ *Arterial System* *.

The *Aortic arch* gives off first an *innominate artery* and then the *left subclavian* separately. These matters are not mentioned

Text-fig 11.

A  B

Intrathoracic aorta of A. ***Helictis personata*** **; B.** ***Galictis barbara.***

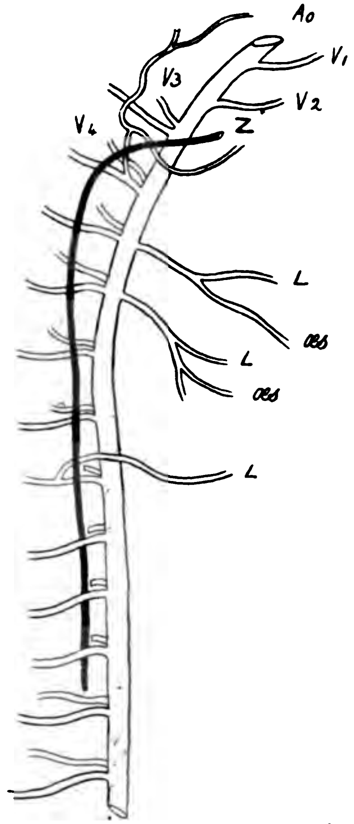
Ao. Aorta; *L.* Branches to lung; *œs.* Branches to œsophagus; *v.* Intercostals; *z.* Azygos vein; *T.* Branch to trachea; *D.* Phrenic arteries.

by Garrod in his account of *Helictis subaurantiaca*, and indeed

* The arteries of the brain are dealt with under the description of that organ.

he gives no account of the vascular system at all. The innominate first gives off the left carotid, and then very shortly after divides into the right subclavian and right carotid. The aorta in the thoracic region gives off eleven pairs of ***intercostal arteries***, the

Text-fig. 12.



Intrathoracic aorta of *Suricata tetradactyla*.

Lettering as in text-fig. 11.

eleventh being just in front of the diaphragm. It is important to notice that these arteries are paired throughout, each artery of the pair arising separately from the aorta: important because in some mammals (e. g. *Chinchilla*) the intercostals arise as single

arteries and afterwards divide into right and left halves. The first pair of intercostals corresponds to the first branch of the Azygos *. The first six pairs of intercostals lie entirely to the left of the Azygos; the 7th artery on the right side and those which follow lie to the right side of the Azygos. This point, I take it, is where originally the now missing right aortic arch joined the left aortic arch. In this region the aorta also gives off a number of fine slender branches to the œsophagus and to the lungs. The first of these branches arises a little way down the first right intercostal and supplies the windpipe; from or in the immediate neighbourhood of the next four right intercostals arise twigs for œsophagus and lungs; then follows a gap of two intercostals, the last twigs arising from the 8th right intercostal. From the last intercostal in front of the diaphragm arises a diaphragmatic artery on each side; another diaphragmatic artery springs directly from the aorta behind the diaphragm, and independently of an immediately following suprarenal artery.

I have carefully and, I hope, exactly compared the prediaphragmatic arteries of *Helictis* with those of its ally *Galictis* and with those of the Æluroid *Suricata*.

The former, as might be expected, shows greater resemblances to *Helictis* than does the latter. There are, however, also differences. There are 10 instead of 11 pairs of intercostals in front of the diaphragm, or, to be more absolutely accurate, 10 on one side and 9 on the other; for the first intercostal has not a fellow and belongs to the left side. The fifth right intercostal is the first which passes to the outside of the Azygos vein. The pulmonary and œsophageal branches arise in every case from the right intercostal vessels, and I counted four of them which have the following position: the first three arise from the first three right intercostals; the fourth springs from the fifth right intercostal.

In *Suricata tetradactyla* there are 12 intercostals on the right side in front of the diaphragm and two additional ones on the left side. The most important pulmonary and œsophageal arteries arise separately from the aorta, though some spring from right intercostals. The 8th right intercostal is the first which passes over the Azygos vein.

* This vessel, as in most mammals, is present only on the right side.

3. Contributions to the Osteology of Birds.—Part VII.* *Eurylæmidæ*; with Remarks on the Systematic Position of the Group. By W. P. Pycraft, F.Z.S., M.B.O.U.

[Received March 30, 1905.]

(Plate II.† and Text-figures 13–15.)

Contents.

i. Introductory Remarks.

The present paper is intended to form the first of a series on the osteology of the Passeres, and, in order to increase its value to the systematist, characters other than osteological will be discussed where necessary. By this means it is hoped that that most difficult of ornithological problems—the classification of the Passeres—will be materially aided.

The labours of Garrod, Forbes, and Fürbringer have resulted in the accumulation of a considerable pile of facts concerning the soft parts of the Eurylæmidæ, but comparatively little has been done in the way of osteology.

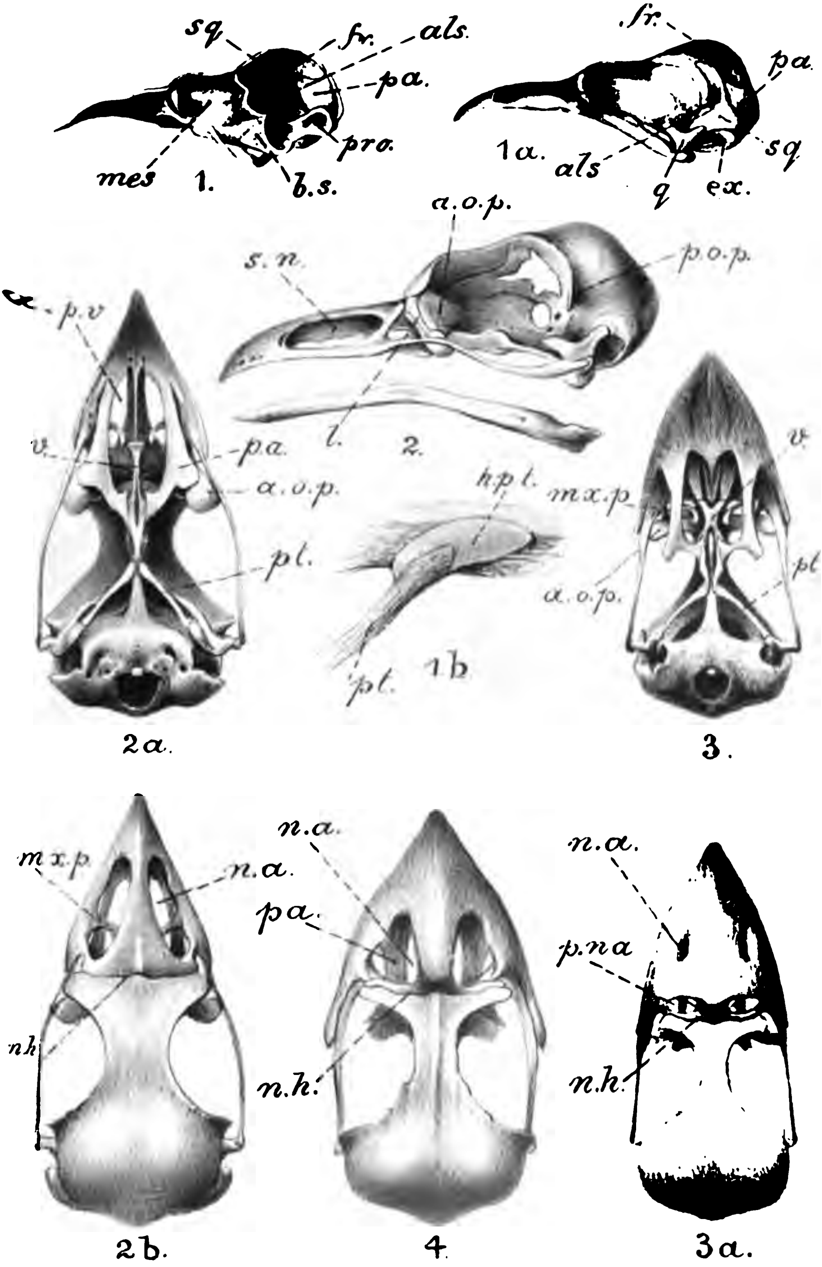
My work, it may be as well to state here, has been hampered by paucity of material, since several genera are entirely unrepresented in the Collection of the British Museum (Natural History). Doubtless these gaps will be filled in course of time, and the lacunæ, unavoidable in this contribution, can then be filled up. Skeletons of nestlings are especially wanted.

ii. The Skull of the Adult.

The skull of the Eurylæmidæ is remarkable for the extreme specialisation which it displays, though these birds are of an undoubtedly primitive type. That changes so considerable as are here to be noticed should have taken place in the skull is unfortunate, since thereby valuable evidence on questions of ancestry has been lost.

It is not an easy matter to express exactly what are the characteristic features of the Eurylæmid skull, or, rather, it is not easy to set down diagnostic characters, since it presents considerable and often wide differences in different genera. Superficially it

* For Part VI. see P. Z. S. 1903, vol. i. p. 258.
† For explanation of the Plate, see p. 56.



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OSTEOLOGY OF THE EURYLÆMIDÆ.

presents an undoubted resemblance, in some respects, to the aberrant *Procnias*, in others to the Swallows.

The following characters will, however, probably suffice:—

The beak is of great size, nearly as broad as long, and joins the cranium by a more or less perfect nasal hinge; free lachrymals are wanting, save in *Calyptomena*; palate ægithognathous; palatines short, broad, wide apart, and produced backward into prominent spurs; vomer truncated, much reduced and terminating posteriorly in a pair of slender limbs; pterygoids and palatines articulating by means of an oblique joint; maxillo-palatine processes reduced to long slender rods slightly expanding at their termination beneath the vomer; basipterygoid processes wanting; postorbital processes obsolete; squamosal process prominent

The Occipital Region.

The foramen magnum is cordiform, its apex rising only slightly above the level of the superior margin of the rim of the tympanic cavity. The plane of the foramen inclines downwards rather than backwards, as in the Capitonidæ, but not to such an extent as in the Bucconidæ. The base of the foramen is not raised above the level of the basi-cranial axis. The *supra-foraminal ridge* is barely traceable.

There is no lambdoidal ridge, such as is met with in the Capitonidæ for example, but the cranium above the occipital foramen presents a fairly prominent cerebellar dome, bounded on either side by a subcircular depression (the supraoccipital fossa). Above this region the skull rises considerably and presents a gently rounded surface.

The tympanic wings of the exoccipital are considerably developed to form a pair of downwardly directed plates, the *processus alæ exoccipitalis inferior*, having a convex border and a convex surface with recurved free edge: through these plates the semicircular canals can be faintly traced.

The Cranial Roof (Pl. II.).—The cerebral rises vertically above the cerebellar dome and is of considerable width, being wider than long. In regard to the position of the cerebral with relation to the cerebellar dome, the Eurylæmidæ agree with the typical Passeres and the Cypseli, and differ from the Capitonidæ, for example, wherein the cerebral lies *in front* of the cerebellar dome. The parietal region is marked by a moderately well-defined temporal depression, the "temporal fossa," which, however, does not extend further inwards than the outer margin of the supraoccipital fossa. This is a Passerine feature; in the Coraciiformes these fossæ usually meet in the middle line, forming a more or less well-marked sagittal crest.

The temporal fossæ in the Eurylæmidæ are mainly responsible for the formation of the well-marked squamosal prominences.

The interorbital region is marked with a more or less distinct median groove, sometimes with a low ridge. Immediately behind

the base of the beak it expands considerably and is supported from within by outstanding antorbital plates. Lachrymals, except in *Calyptomena*, are absent, and consequently take no share in the formation of the preorbital region of the skull. In this particular the Eurylæmidæ agree with the bulk of the Passeres, in which, however, vestiges of the lachrymal are frequently present.

The frontals terminate abruptly in front, not extending beyond the level of the anterior border of the mesethmoid. The nasals and nasal-processes of the premaxilla are also sharply truncated caudad; thus, at their meeting with the frontals and mesethmoid a freely moving nasal hinge is formed (Pl. II. figs. 2 *b*, 3 *a*, 4). The incipient stages in the development of such a hinge can be studied in *Chasmorhynchus*—one of the Cotingidæ.

The Base of the Skull.

The basitemporal plate is slightly hollowed in the middle line, and is continued forward for some distance on to the parasphenoidal rostrum; owing to the small size of the brain its free edge projects beyond the level of the brain-case. To appreciate this point the skull of one of the Eurylæmidæ should be compared with say that of *Menura* or *Corvus*, where, it will be found, the basitemporal plate fails to conceal the brain-case when the skull is seen from below. The edge of this plate is free only at its apex.

Not even vestiges of the basipterygoid processes remain.

The parasphenoidal rostrum is long and slender.

The occipital condyle is spherical and depends from the roof of a shallow pre-condylar fossa.

The Lateral Aspect of the Cranium. (Pl. II. fig. 2.)

The *tympanic cavity* is small, shallow, and has little or no floor. The constriction of the skull-wall in the temporal region, to form the "temporal fossæ," gives the tympanic cavity the appearance of the aperture of a tube, the cylinder of which is formed by the "squamosal prominence" and lateral occipital wing.

The roof of this cavity is formed by the under surface of the *processus zygomaticus squamosi*. Its floor in part by the lateral occipital wing and in part by the ossification of tissue extending between this wing and the external angles of the basitemporal plate; but this region is much cut away.

Within the cavity three apertures will be found in the dried skull after the removal of the tympanic membrane. The largest of these is the mouth of the *recessus tympanicus anterior*. Immediately outside this, and below the otic articular surface for the quadrate, is the fenestral recess: this is very small, and neither the fenestra ovale nor the rotunda can be distinguished within it, though the columella is in position above; and behind the fenestral recess a cluster of minute pneumatic apertures will be found, corresponding to a similar group commonly found in the higher

Passeres. In shape and position, however, this group of foramina more nearly resembles its counterpart in the Bucconidæ. These foramina form a sort of cribriform plate guarding the mouth of the *recessus tympanicus posterior*, which is much reduced. The *recessus tympanicus superior* is of small size, and opens externally into the tympanic cavity by a small aperture lying between the squamosal and otic heads of the quadrate. The aperture is bounded externally by a short, pointed *processus articularis squamosi*.

The Squamosal Prominence.—It has already been pointed out (p. 32) that the constriction of the temporal region of the cranium has given the tympanic region a sort of individuality not met with in the skulls of the higher Passeres, but common among the lower types, and among the Coraciiformes.

In the Eurylæmidæ the free edge of this prominence projects shelf-like beyond the head of the quadrate. It is continued forwards into a hastate *processus zygomaticus squamosi* directed downwards and outwards. From the base of the inferior surface of this process projects a short pointed *processus articularis squamosi*; between these two processes the head of the quadrate is firmly grasped.

The *temporal fossæ* are especially deep in *Corydon*. As in other genera, they are linguiform in shape and do not extend inwards beyond the outer border of the supraoccipital fossa.

The *trigeminal foramen* pierces the skull-wall at about the level of the otic articular process for the squamosal, but some considerable distance mesiad thereof.

The *orbito-sphenoid* does not ossify. The *interorbital* septum is largely fenestrated.

The interorbital region of the frontals is generally very narrow so that the orbits are only very partially roofed. In front the orbit is bounded by a ⊢-shaped antorbital plate. In *Calyptomena* the interorbital region is wide.

The lachrymal, in *Calyptomena* (Pl. II. fig. 2, *l.*), has the form of a sigmoid rod more or less clubbed at each end. The upper end would perhaps more correctly be described as hammer-shaped, and is completely overshadowed by wide expansions of the frontal. The whole ossicle is embedded in a groove carved out of a very much swollen antorbital plate. The close resemblance between the lachrymal of *Calyptomena* and that of *Chasmorhynchus* is most remarkable. Both are embedded in the antorbital plate, and both have the same sigmoid flexure. Only in the larger size of the orbital end can the lachrymal of *Chasmorhynchus* be distinguished from that of the Eurylæmid *Calyptomena*.

In all the other Eurylæmidæ, however, the lachrymal appears to have been lost; further, the antorbital plate has been reduced to a thin ⊢-shaped plate.

The Ethmoidal Region.—The *mesethmoid* is greatly reduced by the fenestration of the interorbital septum. The *antorbital plate* which bounds the orbit in front is ⊢-shaped and attached to

the mesethmoid by a horizontal plate of bone, almost rod-like in some species. The vertical, hamulate portion of the plate, by its upper limb, considerably adds to the width across the frontal, the lower, descending, process turns outwards to reach the quadrato-jugal bar. In the extraordinarily wide-mouthed genus *Corydon*, however, the quadrato-jugal bar stands far from this descending process.

The olfactory chamber, owing to the extremely reduced condition of the maxillo-palatines, in the macerated skull is without a floor, in the majority of the genera of this group; but in two skulls, *Eurylæmus* and *Cymbirhynchus*, in the British Museum Collection, this is more or less filled up by the ossification of a pair of turbinals, one on either side of the septum nasi, which apparently answer to the concha media. Pyriform in shape, each extends from the narial aperture backwards to the anterior horn of the vomer, where it becomes attached. Above and behind this is an oat-shaped and laterally compressed turbinal answering to the concha posterior.

The nasal septum, in *Calyptomena*, is formed by a thin sheet of bone running along the whole length of the under surface of the nasal process of the premaxillæ. In *Eurylæmus*, *Cymbirhynchus*, and especially in *Corydon*, this septum becomes greatly swollen and grooved on its under surface.

The Cranial Cavity.—The *mesencephalic fossa* is capacious. Its floor sweeps rapidly upwards to form a strongly marked basin-shaped cavity. This upward rising of the floor is much more conspicuous than in some other genera, e. g. *Menura* or *Corvus*.

The *internal auditory* meatus is represented only by a shallow depression. Immediately above and somewhat in front of this lies the *trigeminal foramen*. This, opening under a strong ridge, leads immediately into a deep groove across the floor of the mesencephalic fossa and thence through the under wall of the skull. All the branches of v leave by this foramen. There is no separate foramen for the ophthalmic (v^1) (orbito-nasal); and in this respect the Eurylæmidæ appear to agree with all the other Passeriformes. The *vagus* foramen lies at the bottom of a deep fossa.

The *cerebellar fossa* is small, relatively to the cerebral, sharply defined, and has the supra-occipital region marked with prominent horizontal ridges. The *floccular fossa* forms a conspicuous moderately deep and more or less pyriform depression, sharply bounded caudad by the anterior semicircular canal.

The *mesencephalic fossa* is of considerable size and, as in other Passeriformes, extremely well defined by a strong vertical ridge above, and an equally prominent ridge formed by the *pro-otic* below.

The *pituitary fossa* takes the form of a narrow tube rising vertically from the floor of the skull. The *dorsum sellæ* is reduced to a knife-like edge. The pre-pituitary region is produced into a moderately well-defined optic platform, triangular in shape.

The *cerebral fossæ* are relatively of considerable size, though relatively smaller than in *Corvus* for example. Thus, in the Eurylæmidæ the cerebral fossa is only distinguishable from the mesencephalic fossa by reason of the boundary-line of the tentorial ridge. In *Corvus* the mesencephalic fossa forms a totally distinct basin-shaped cavity, lying as it were within the cerebral fossa, which dips down to the outer side and below the level of the fossa in question in the form of a deep pocket. *Menura* represents a half-way stage between the Corvidæ and Eurylæmidæ. In *Menura*, moreover, the roof of the cerebral fossa is marked by a low ridge roughly dividing the fossa into two equal parts.

There is a well-developed bony *falx*.

The *olfactory* fossæ are reduced to a pair of small pits. But there are strong impressions of an olfactory tube to be found in the fore part of the cerebral fossa of the Eurylæmidæ.

The Premaxilla.

The premaxilla in the Eurylæmidæ forms the major part of the upper half of the beak. Hooked at the tip, and of extreme breadth, it recalls in many respects that of many of the Coraciidæ, e. g. *Eurystomus*, on the one hand, and of some Caprimulgi, e. g. *Podargus*, on the other. When these several types come to be compared, however, these resemblances will be found to be but slight.

More significant is the close resemblance to the Cotingidæ. This is well brought out in the skull of *Calyptomena*, which, as will be shown presently, presents many features in common with *Chasmorhynchus*. The number of other skeleton characters which these two forms possess in common suggest affinity between the two groups, rather than homoplasy.

In *Calyptomena*, which I propose to take as the typical Eurylæmid for the purpose of comparison, the body of the premaxilla is moderately large. The nasal process, fusing with the nasals, is sharply truncated caudad, and articulates with the frontals by a hinge. In this respect the Eurylæmid skull resembles that of the Podargidæ, and not of the Coraciidæ.

The low position of the skull of *Calyptomena* is indicated by a comparison of the narial aperture with that of the skulls of other Eurylæmid genera.

In *Calyptomena* the nasals are of the typical holorhinal shape with an obliquely sloping descending process. The nasal fossa, in the dried skull, is a long oval aperture showing, within the cavity, a narrow ridge of bone continued from the palatal border forwards to meet a low septum hanging from the middle line of the nasal process of the premaxilla. The septum represents the ossified remains of the *septum nasi*; the small plate of bone running inwards from the level of the tip of the palatine is a portion of the alinasal cartilage which has become ossified.

Corydon, *Eurylæmus*, and *Cymbirhynchus* differ conspicuously from *Calyptomena* in this matter of the narial aperture, as may be seen by a comparison of figs. 2 *b*, 3 *a*, 4, Pl. II.

In all three genera the nasal is reduced to its smallest possible limits, little more than an arcuate bar being left. Of this, one half represents the descending process of the nasal, the other the body of the bone,—now merely a rod joined at its inner end to the nasal process of the premaxilla, and affording the means of articulation with the frontals. This, as I have remarked, takes the form of a nasal hinge. In *Eurylæmus* and *Corydon* the nasal fossa, as in *Calyptomena*, is open in the dried skull, the actual position of the nasal orifice in the living bird being indicated by semicircular grooves in the anterior border of the nasal fossa. The circle completing the rest of the fossa in the living bird was roofed by the alinasal wall. In *Cymbirhynchus* this wall almost completely ossifies, leaving an oval narial aperture, and a small semilunar space immediately in front of the nasal (fig. 3, Pl. II.).

In the Eurylæmidæ the floor of the olfactory chamber is open behind, revealing in *Calyptomena* an ossified sheet-like nasal septum, which in *Corydon* becomes immensely swollen.

In the Coraciæ, certain Caprimulgi and Pici the floor of the olfactory chamber is more or less ossified. In *Eurystomus* and the Bucconidæ there is a long palatal fissure, which at first sight appears to correspond to the huge palatal cavity of *Eurylæmus*. An examination shows, however, that this vacuity leads into a spacious cavity underlying the olfactory chamber and formed by the inflation and absorption of tissue of the nasal septum. In *Podargus* the palatal surface of the premaxilla is completely ossified, and the olfactory chamber is reduced to the smallest possible limits.

In *Corydon* the nasal process of the premaxilla is immensely swollen and rises far above the level of the nasal hinge. The frontal is similarly swollen immediately above this hinge. The intermediate stages between this condition and that found in *Calyptomena* can be studied in *Cymbirhynchus*. *Corydon*, indeed, would appear to have reached the high-water mark of specialisation in the matter of the jaws, among the Eurylæmidæ.

The Maxillo-jugal Arch.

The *maxilla*, as usual, is in the adult completely fused with the premaxilla. In *Corydon* the maxillary region of the jaw is highly developed and forms a large semicircular plate, the convexity forming its free edge and projecting downwards far beyond the level of the quadrato-jugal bar.

The *maxillo-palatine processes* in *Calyptomena* take the form of a pair of delicate rods projecting backwards at a very marked angle from the body of the maxilla, which, at this point, is perforated by small pneumatic apertures. These rods, on each

side of the skull, terminate immediately beneath the free end of the vomer.

That these processes are degenerate there can be no doubt. They have probably been derived from a condition precisely similar to what obtains in *Chasmorhynchus*. In the latter, these processes are swollen and spongy in character. Arising from the maxilla at a point almost immediately below the descending process of the nasal (in *Calyptomena* they arise distad of this point), they extend backwards so as to run on either side of and beneath the vomer for nearly one-fourth of its length.

In *Corydon* and *Cymbirhynchus* these processes are more slender than in *Calyptomena*. In *Cymbirhynchus* they are hook-shaped.

Probably, as I have remarked, the maxillo-palatines of *Calyptomena* at an earlier stage closely resembled those of *Chasmorhynchus*. It seems also highly probable that these, in turn, were derived from yet more primitive and much more extensive triangular plates such as have been retained by the Tyrannidæ. The palate of *Tityra*, indeed, shows how easily the Eurylæmiform palate could have obtained its peculiar maxillo-palatines.

The quadrato-jugal bar in *Calyptomena* as in *Chasmorhynchus* is sigmoidally curved, as much so as in some Spheniscidæ. In *Corydon* and *Cymbirhynchus* it is straight. There are no separate elements distinguishable in this bar.

The Vomer, Palatines, and Pterygoids.

The *vomer* (Pl. II. fig. 2 *a*), in *Calyptomena*, is roughly oar-shaped in front and terminates caudad in a pair of long, slender limbs, bowed outwardly so as to enclose a space through which the parasphenoidal rostrum may be seen, and fused completely with the palatines. The free end of the blade is truncated, and has the angles produced into minute processes, thus showing that the vomer was earlier of a more pronounced Ægithognathous type.

In *Corydon* the vomer is much reduced, being represented by a short, broad, oblong body produced caudad into a pair of widely separated and slender rods which articulate with the palatines. The free end of the vomer is squarely truncate with prominently produced angles. The dorsal aspect of the vomer is closely applied to the base of the *septum nasi*.

Cymbirhynchus resembles *Corydon* in the shape of the vomer, but differs therefrom in that it is slightly constricted between the free end and the origin of the posterior cornuæ, which fuse completely with the palatines, forcing the parasphenoidal plates thereof away from their normal relationship to the parasphenoid.

In the Coraciidæ the vomer is either wanting or reduced to a mere spicule, e. g. *Eurystomus*.

In *Chasmorhynchus* the vomer is larger than in the Eurylæmidæ. Ægithognathous anteriorly, it terminates posteriorly in a pair of

broad limbs indistinguishably welded with the palatines, agreeing in this with *Calyptomena* and *Cymbirhynchus*.

The *palatine* (Pl. II. fig. 2 *a*) in *Calyptomena* is a long bone: anteriorly rod-shaped, it extends backwards as far as the under surface of the antorbital plate, when, after sending outwards a prominent, rounded elbow—"transverse bone"—it turns abruptly inwards, ultimately forming a roughly spatulate plate, bent upon itself so as to form a long linear surface running along the parasphenoid rostrum, and fusing mesiad with the vomer and a free downwardly hanging curtain to form a cavernous space in the roof of which is the base of the vomer.

The palatine of *Chasmorhynchus* differs from that of *Calyptomena* in the greater width of the hinder laminated portion and the more extensive development of the inferior free edge, forming the cavernous space beneath the vomer. This edge now appears rather as a shelf-like projection developed from the inner border of the shaft of the palatine.

In *Cymbirhynchus* the palatine shaft is broader than in *Calyptomena*, and this increased breadth is especially noticeable at its junction with the body of the premaxilla. The latter, as has already been pointed out, is much more conspicuous than in *Calyptomena* and terminates in a doubly crescentic free edge synchronously with the palatines. Thus a relatively enormous oblong space is enclosed. In *Corydon* these features are still more exaggerated, the "elbow" is also more strongly marked.

In broadness and the truncated form of the shaft of the palatines, the more specialised Eurylæmidæ recall the Podargidæ, wherein the body of the premaxilla is still more developed and the truncation of the palatine distally more marked. Both in the specialised Eurylæmidæ and the Podargidæ the truncation of the vomer appears to have been brought about to facilitate the movements of the nasal hinge, which in both types lies immediately above the anterior ends of the palatines, while in the more generalised *Calyptomena*, which lacks a nasal hinge, the palatines run far forwards.

The *pterygoid* in *Calyptomena* (Pl. II. fig. 2 *a*) is a long, slender, rod-shaped bone, laterally compressed, and perforated by a pneumatic foramen at its articulation with the quadrate. At its anterior end it meets its fellow of the opposite side in the middle line; and immediately sends upwards and forwards a subcrescentic plate which, embracing the parasphenoidal rostrum by its plane surface, affords attachment along its inferior border to the vomer. Late in life the articulation with the vomer is succeeded by anchylosis. Certain points concerning the morphology of the end of the pterygoid will be discussed in the section dealing with the nestling skull (p. 43).

In *Chasmorhynchus* the anterior ends of the pterygoids do not meet in the middle line but impinge instead directly against the parasphenoidal rostrum, forming therewith a pedate articulation, which is largely augmented by "hemipterygoid" elements

corresponding to the sub-crescentic plates of *Calyptomena*. These hemipterygoids, in both the Eurylæmid and Cotingid forms, articulate with the palatines, in the adult, by means of an oblique suture.

Corydon and *Cymbirhynchus* differ in no essential features from *Calyptomena*.

The *quadrate* is peculiar in that, in common with the Tyrannidæ and some other Passerine forms, it sends out a strong spur for the articulation of the quadrato-jugal bar. This spur projects like a buttress laterad of the outer condyle for the lower jaw. The squamosal and otic heads are closely approximated. The former is wedged in between a prominent *processus articularis squamosi* behind, and an equally well-developed *processus articularis zygomaticus* in front. In *Corydon* these processes are expanded laterally so as to overhang the head of the quadrate, but at the same time they afford this element a greater freedom of movement than in *Calyptomena*. *Cymbirhynchus* and *Eurylæmus* are intermediate in character in this respect.

The Mandible.

The mandible, in the Eurylæmidæ, is much bowed outwards to a very considerable extent. In *Calyptomena* it has only a relatively small symphysis: is truncated posteriorly, and shows little or no trace of the separate elements of which it is composed. The internal angular process is moderately well developed, and is perforated by a small pneumatic foramen. The rami, in their general shape, are rod-like, and slightly compressed laterally.

In *Corydon* and *Cymbirhynchus*, however, there is an abrupt transition between the malar region of the mandible and that portion covered by the rhamphotheca, which is most markedly thicker and broader than the hinder region. The symphysial region is very broad and spoon-shaped. The internal angular process is more spine-like than in *Calyptomena*, and there is a feebly-developed posterior angular process.

The Hyoid.

The hyoid of the Eurylæmidæ resembles that of the higher Passeres. The basihyal (os entoglossum) is made up of a pair of boomerang-shaped ossifications placed *dos à dos*, so that a long free process is produced backward beyond the articulation with the basibranchial 1. Basibranchials 1–2 are fused; the latter, however, is a long cartilaginous style. The ceratobranchial and epibranchials are of moderate length; the latter are cartilaginous at the free ends.

In *Corvus*, for example, among the higher Passeres, the basihyals are long and straight, and run parallel with one another, yet so as to leave a median space between them.

iii. The Skull of the Nestling. (Pl. II. figs. 1 & 1*a*.)

It is a matter for regret that the British Museum Collection of nestling skulls of Eurylæmidæ is limited to half-grown specimens of *Eurylæmus ochromelas*, and these have suffered somewhat severely as a consequence of having been preserved in formol.

a. *Cartilage-bones.*

The *basioccipital* cannot, in these skulls, be more than imperfectly traced, having become fused with the lateral occipitals.

The *exoccipital*, or lateral occipital, is a large, more or less linguiform plate presenting a broad convex external border, the inferior segment of which forms the tympanic cavity, while the superior arc of the curve is applied in part to the base of the squamosal and in part to the parietal. It is bounded mesiad by the supraoccipital and the occipital foramen, which excavate a considerable moiety from its internal border. Inasmuch as the exoccipital comes into contact with the parietal, it resembles that of the Cuculidæ.

The *supraoccipital* is short antero-posteriorly, and is not yet ossified; its superior margin being W-shaped and leaving a large fontanelle between itself and the parietals. Laterad it has fused with the lateral occipitals, leaving only a faint tell-tale notch to indicate the junction.

The *pro-*, *epi-*, and *opisthotic* bones are now completely concealed when the skull is viewed externally.

The *basisphenoid* is also concealed, being underfloored by the basitemporal plate.

The *alisphenoid* appears as an oblong plate, having its long axis horizontal.

The *orbito-sphenoid* is still membranous, while the presphenoid has fused with the basisphenoid.

The *mesethmoid* has only just commenced to ossify, and is represented by a small linguiform plate supporting the yet cartilaginous antorbital plate, and bounded in front by the craniofacial fissure. The interorbital septum formed by the backward extension of the plate is as yet only outlined in cartilage.

The olfactory cavities occupy less than half of the so-called anterior narial apertures as seen in the dried skull. The actual anterior nares, in *Eurylæmus ochromelas* for example, are small and round, and placed at the extreme anterior angle formed by the divarication of the nasal and maxillary processes of the premaxilla. The superior segment of this circle is formed by membrane, and this extends backwards and inwards as a subtubular sheet to be attached to the antorbital plate. Mesially this tube is shut in by the nasal septum, and inferiorly by membrane forming the roof of the palate. Within the chamber thus formed lies a long, somewhat spatulate cartilaginous turbinal extending backwards, by a short stalk, to the anterior end of the vomer. The free end

of the spatulate process lies on a level with, but mesiad of, the external aperture. Without this chamber is a large sinus roofed by the rhamphotheca, floored by membrane supported by the maxillo-palatine process, and closed posteriorly by the antorbital plate lying external to the nasal chamber. In the dried skull this sinus is included as part of the external narial aperture.

The *quadrate*, though not yet completely ossified, differs in no material particular from that of the adult.

b. *The Membrane-bones.*

The *parietal* is roughly quadrangular in shape; its superior external angle is drawn upwards into a point, its inferior external angle forms a sweeping curve. Its mesial border is not yet ossified in the skull now described. A small portion of its inferior border, lying between the supraoccipital and squamosal, comes into actual contact with the exoccipital.

The *frontal* along its posterior border follows the curve of the parietal: anteriorly, in the mid-orbital region, it becomes reduced to a narrow band, and finally terminates in a strap-shaped process underlying the nasals. Before leaving the cranial cavity its free edge passes downwards and inwards to join the alisphenoid inferiorly. The rim of this inturned plate is overlapped by a long tongue-shaped process of the squamosal (Pl. II. fig. 1 *a*).

The *squamosal* is a somewhat remarkable bone. Roughly ⊥-shaped, the horizontal region overlaps, mesiad, the lateral occipital and extends so as nearly to reach the supraoccipital; laterad it overhangs the tympanic cavity and terminates in a pointed *processus zygomaticus squamosi*. The vertical shaft arising from this base is roughly sword-shaped, with a slightly decurved pointed tip. About one-third of this blade arises above the level of the parietal to overlap the frontal as already described. Immediately above the level of the superior border of the alisphenoid this blade develops a barely perceptible prominence, which supports a small cartilaginous nodule—the anlage of the postorbital process.

Another most noteworthy feature of the squamosal in this skull is the fact that the greater part thereof appears on the inside of the skull: only, indeed, the extremities of the horizontal and vertical portions being excluded. Compare figs. 1, 1 *a* (Pl. II.).

In the most primitive types of Avian skull, it will be remembered, the squamosal is either entirely excluded from any participation in the formation of the brain-case, or only a very small area is admitted. Originally a quite superficial bone, it has gradually absorbed the underlying osseous tissue, till eventually it has forced itself into the very walls of the cranial cavity, and this is especially the case in the skull of *Eurylæmus ochromelas*.

I am unfortuately unable at the present time to make any extensive series of comparisons between the form of the squamosal in the Eurylæmidæ and that of the Coraciiformes, or the

Menuridæ and other Passeriform types, owing to lack of material. Such a comparison I believe would be valuable.

So far, the peculiar squamosal of the Eurylæmidæ resembles most nearly, among the Coraciiformes, that of the Capitonidæ. But the likeness is but general, and seems to point to the Capitoniform type as being the more primitive. Herein, this element is roughly quadrangular in type, but has the antero-dorsal angle produced into a point, which, however, does not extend on to the frontal. Its mesial border is, indeed, exactly coterminous with the external lateral border of the parietal. The alisphenoid in this skull is prominent and forms a large triangular block fitting into the deeply concave anterior border of the squamosal on the one hand, and overhung by the postorbital region of the frontal on the other. The postorbital process appears to be formed in part by the alisphenoid, and in part by the frontal. The squamosal takes no part whatever in its formation. These relations can be seen in the skull of *Calorhamphus.*

The resemblance to the squamosal of the Passeriformes is close, but is of a kind such as to leave little doubt but that this element in the Eurylæmidæ is much the more specialised: a fact which is somewhat surprising, and is at the same time not without significance.

Comparing the squamosal of *Eurylæmus ochromelas* with that of the Rook (*Corvus frugilegus*), it will be found that in the latter this element is of considerable size, conical in form, and rises superiorly to overlap the frontal as in *Eurylæmus.* The base of this cone is broad, and its postero-internal angle is produced backwards and inwards to form a wedge between the parietal and lateral occipital.

It is from a squamosal of this type that the squamosal of *Eurylæmus* has been derived. This evolution has resulted in a much greater extension of the base mesiad, between the parietal and exoccipital, and in the lateral reduction of the body of the bone so as to transform the sometime cone into a xiphoid shaft springing from a broad base. These changes will become the more apparent by a reference to fig. 1 *a*, Pl. II.

The *nasal* varies considerably in form in this group. Unfortunately, I have not material at my command which will enable me to make a comparison of the early stages of growth of these several varieties.

The *lachrymal* is not yet ossified.

The *premaxilla* apparently lacks palatine processes. What appear to be vestiges of these seem rather to be ossifications of the membrane forming the floor of the anterior region of the nasal chamber. This point can only be solved by a further examination of well-preserved material.

The *maxilla* appears to be unusually large in the skull, but the decalcification caused by the formalin in which this specimen was preserved has almost obliterated the premaxillary and quadratojugal sutures.

The *quadrato-jugal* is long, extending to beyond the middle of the orbit.

The *vomer* is not yet ossified.

The *palatines* differ from those of the adult in that the trans-palatine elements (?) are as yet membranous.

The *pterygoid* is rod-shaped, bent at its posterior extremity at an obtuse angle, so as to fit closely to the parasphenoidal rostrum. The free end of this rod is pointed, and bears a small pointed piece of cartilage. Whether this represents the hemipterygoid, or, as seems more likely, the unossified extremity of the shaft, is a point which can only be determined by the examination of somewhat older skulls.

The palatine extends backwards beneath these bent limbs of the pterygoid.

The apparent absence of the hemipterygoid is a point of considerable interest. The interpretation to be placed upon this fact is, I think, not that the pterygoid shaft retains its primitive integrity, but that the hemipterygoid element has been lost, just as it has in many other groups of birds. My reason for this view is that the vomer, which shows various grades of reduction in the Eurylæmidæ, is supported entirely by the palatines, as in all other cases where the hemipterygoid has been greatly reduced or is wanting.

There is nothing remarkable in the absence of this element, because, as has been shown, the skull in this group is highly specialised in many ways.

The elements of the mandible are as yet distinct.

iv. The Vertebral Column.

All the presynsacral vertebræ are heterocœlous and free.

The cervical vertebræ are characterised by the deeply incised neural plates of the 6th–10th vertebræ, where the posterior zygapophyses are borne upon the under surface of the free ends of long beams.

The atlas has the odontoid ligament perforated.

The axis bears a large tooth-like neural spine and a large pair of hyperapophyses. The second and third have large quadrangular neural plates, the hinder angles of which in the third vertebra are produced upwards into strong hyperapophyses. The outer borders of these plates are pierced, on each side, by a small foramen. The hyperapophyses of the 5th to 8th vertebræ are placed about midway between the neural spine and the posterior zygapophysis. From the 5th to 11th vertebræ the neural plates are deeply incised both before and behind the neural spine. The neural spines gradually decrease in size from before backwards, so that from the 9th to the 12th they are represented only by the merest tubercle. Hypapophyses are borne by the 2nd, 3rd, 4th, and 5th vertebræ; the 7th to 10th bear catapophyses, feebly developed; hypapo-

physes again succeed from the 11th vertebra and are continued backwards to the thoracic.

The cervical vertebræ are 12 in number. There are three cervico-thoracic; that is to say, there are three vertebræ bearing free cervical ribs. The 1st pair are reduced to the merest vestiges; the 2nd pair are long, bear vestigial uncinates, but no sternal segment; the 3rd pair bear large uncinates and a long styliform sternal segment, which does not, however, reach the sternum. Thus, it is obvious that, at no distant date, these three vertebræ formed part of the thoracic series and articulated with the sternum. They differ, moreover, in form from the true cervicals, and resemble the thoracic series in having broad outstanding diapophyses.

The cervical and cervico-thoracics of the Eurylæmidæ differ conspicuously from those of the Menuridæ and of the Coraciiformes, and resemble rather those of the higher Passeres.

The thoracic vertebræ, six in number, have moderately developed, quadrangular, neural spines. Only the 1st thoracic bears a small hypapophysis. The centra are pierced by pneumatic foramina. The last thoracic has been incorporated with the synsacrum.

Twelve vertebræ enter into the composition of the synsacrum in *Calyptomena* and *Cymbirhynchus*; 13 in *Corydon*. The numerical differences are as follows:—

	Calyptomena.	*Cymbirhynchus.*	*Corydon.*
Thoracic	1	1	1
Lumbar	2	2	3
Lumbo-sacral	3	2	2
Sacral	2	2	2
Caudal.........	4+8 free caudal	5+8 free caud.	5+8 free caud.
Total	12+8 „	12+8 „	13+8 „

Thus *Calyptomena* appears to have lost 1 post-sacral and *Cymbirhynchus* 1 pre-sacral. *Corydon* would appear to express the primitive number of these segments.

The 2nd lumbar in *Calyptomena* bears a large pair of ventrilateral processes abutting against the pre-ilia. The 1st sacral vertebra lies immediately caudad of the hinder margin of the acetabulum. The dorsi-lateral processes of the sacral and caudal vertebræ are long, and, by the ossification of the tendinous tissue overlying them, form a broad bony plate dividing the innominates. There are 8 free caudals, including the pygostyle. The diapophyses of those immediately following the synsacral series are not embraced by the innominate, owing to the fact that these are kept apart by the outstanding dorsi-lateral processes of the synsacral series.

Corydon and *Cymbirhynchus* differ from *Calyptomena* chiefly in that the dorsi-lateral processes of the sacral and post-sacral

components of the synsacral vertebræ are shorter, so that the diapophyses of the first precaudal are overlapped by the hinder ends of the innominate.

Well-marked intercentra appear on caudals 5–7, in each of the three genera here described.

v. The Ribs.

The cervical ribs extend from the 4th to the 12th vertebræ. The 1st and 2nd, 10th and 12th, are represented by little more than broad pleurapophysial lamellæ; in the remaining vertebræ, however, these lamellæ are narrow and band-like, and the ribs slender and styliform, extending the whole length of the centrum.

There are 3 cervico-thoracic ribs. The first is reduced, only the capitulum and tuberculum remaining connected by a common base. The second is long, but bears no uncinate; the third bears a short sternal segment, which, however, does not reach the sternum.

There are 5 thoracic ribs, of which 4 only reach the sternum. The uncinates are long and extend backwards to reach the 3rd rib from their base of attachment.

In *Corydon* the sternal segment of the 5th rib articulates by a special facet with the sternal segment of the rib next in front.

vi. The Sternum and Shoulder-girdle.
(Text-figs. 13, 14, pp. 46, 47.)

The sternum of the Eurylæmidæ is typically Passeriform, and presents no very close resemblances to that of any other group. In some features it recalls that of the Cuckoos, in others of the Caprimulgi, but these are not of a nature likely to cause difficulty in confounding the sterna of either of these groups with Passerine sterna.

In the Eurylæmidæ the corpus sterni is short and broad—the breadth nearly equal to the length. The posterior lateral processes are long, extending forwards to a point corresponding to a transverse line through the middle of the corpus sterni; the free ends of these processes are spatulate. The metasternum has its free border squarely truncate, so as to form a continuous line with the free ends of the posterior lateral processes; broken only by the notch enclosed by this process. The anterior lateral processes in *Calyptomena* have their free ends truncated and curved slightly backwards. In *Corydon* these processes are long, pointed and directed forwards. *Cymbirhynchus* is intermediate in this respect, the process being long, truncate, and directed forwards. The articular surfaces for the sternal ribs are confined entirely to these processes.

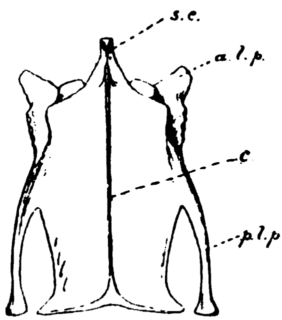
There is no *spina interna*. The *spina externa* shows only the faintest indication of the bifurcate free end which prevails among the Passeriformes (text-fig. 13, *s.e.*). In *Cymbirhynchus* and *Corydon* this spine is triangular in section; in *Calyptomena* it

should rather be described as blade-shaped, the dorsal edge of the blade being much thickened; in other words, the ventrally placed keel of the triangle seen in *Corydon* has in this genus extended downwards. The median line of the dorsal surface of the corpus sterni is deeply grooved, and pierced anteriorly by a large pneumatic foramen. In *Cymbirhynchus*, and to a less extent in *Calyptomena*, the groove is laced across by narrow, irregular bars of bone.

The carina is deep, and has the free (ventral) edge produced forwards. The anterior (vertical) border bears a hollow groove for the reception of the hypocleideum.

The coracoid grooves look directly forwards, and do not meet in the middle line. The dorsal lips are prominent and thickened; the ventral lips are well-defined, but have knife-like edges continued inwards on to the *spina externa*.

Text-fig. 13.



Sternum of *Calyptomena*, showing the simple (unbifurcated) spina externa, *s.e.* *a.l.p.*, anterior lateral process; *c.*, carina; *p.l.p.*, posterior lateral process.

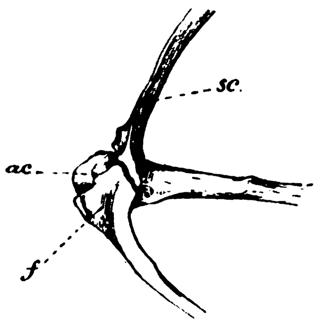
The coracoids are long; as long as, or longer than, the *corpus sterni*. The procoracoid process, though reduced, is still moderately large, and forms a narrow flange of bone, arising beyond the middle of the coracoid shaft and having its free edge directed downwards. Cephalad it articulates with the scapula, and with the clavicle forms the *foramen triosseum*. The procoracoid of the Eurylæmidæ is larger than in the Cotingidæ. In the Picidæ the procoracoid appears to be wanting, and in the higher Passeres it is reduced to the merest vestige, e. g. *Corvus*. The breadth of the base of the coracoid is increased by narrow phalanges of bone, one on either side extending forwards, for about one-fourth the length of the shaft. On the dorsal aspect of the shaft a prominent tongue of bone is sent up to abut against the dorsal lip of the coracoid groove. This at least obtains in *Calyptomena*; in *Corydon* and *Cymbirhynchus* it is less marked.

The *scapula* is long, narrow, and scimitar-shaped. The *furcula*

is long, slender, gently arched, and bears a large hypocleideum, roughly quadrangular in form, and articulating with the anterior edge of the carina. The free ends of the furcula are expanded to form flat plates articulating with the acrocoracoid, procoracoid, and acromion process of the scapula (text-fig. 14), thus enclosing the *foramen triosseum.*

In the form of the sternum and shoulder-girdle the Eurylæmidæ closely resemble the Cotingidæ, especially in the form of the spina externa, which is simple, and thereby differs from the typical Passerine form wherein it is forked. In the Eurylæmidæ this process is more or less spike-shaped, whereas in the Cotingidæ it appears to be generally flabellate. In *Chasmorhynchus* the posterior sternal notches are not so deep as in the Eurylæmidæ. The hypocleideum articulates nearer the antero-ventral angle of the carina; and the coracoids do not develop the internal basal flange found in the Eurylæmidæ.

Text-fig. 14.



Portion of the shoulder-girdle of *Calyptomena*, to show the meeting-point of the scapula, coracoid, and clavicle, forming the inner wall of the *foramen triosseum.*

sc., scapula; *ac.*, acrocoracoid; *f.*, furcula.

In the relations of the articulations between the procoracoid, furcula, and scapula, where these unite to form the foramen triosseum, the Eurylæmidæ are distinctly Passerine, though this arrangement also obtains among the Picidæ—a fact of some significance.

In *Calyptomena*, for instance, the acromion process of the scapula extends downwards along the anterior border of the free edge of the procoracoid, and affords an articular surface cephalad, for the posterior angle of the expanded free end of the furcula. In *Chasmorhynchus* this articulation for the furcula is markedly increased; and this increase apparently reaches its maximum in the Corvidæ, where the acromion forms a long beam-like roof to the foramen triosseum, and a very extensive articular surface for the furcula.

vii. The Pelvic Girdle.

Outside the Passerine series the pelvic girdle of the Eurylæmidæ resembles most nearly that of the Capitonidæ; from which, however, it may be distinguished by the fact that whereas in the Eurylæmidæ the post-acetabular ilium is produced caudad into a spine, in the Capitonidæ this backward extension is broad and bifurcate.

Among the Passeres it approximates most closely perhaps to that of *Chasmorhynchus*. *Cymbirhynchus* only, among the Eurylæmidæ, appears to possess even a vestige of the pectineal process. In *Calyptomena* the pre-acetabular ilium is broad throughout its whole length, and sharply truncated anteriorly. The inferior border thereof is markedly sinuous. The pre-acetabulæ of the right and left sides are widely separated one from another; and rise so as to lie nearly level with the ridge of the neural crest of the synsacrum, thus forming a large, open, *canalis ileo-lumbalis*. The post-acetabular region of the ilium is expanded to form a broad dorsal plane, and passing backwards terminates in a long spine, which, in *Cymbirhynchus* and *Corydon*, is closely applied to the free ends of the transverse processes of the post-synsacral caudal vertebræ.

The *ischium* in *Calyptomena* is long, produced backwards considerably beyond the level of the post-acetabular region of the ilium, and terminates in a downwardly-directed hook-shaped process which fuses with the pubis. *Cymbirhynchus* differs but slightly from *Calyptomena* is this respect. In *Corydon* the ischium is shorter antero-posteriorly, and deeper, than in the two genera just described, and does not project beyond the level of the free end of the post-acetabular ilium. Further, the dorsal border of the pre-ilium is much cut away anteriorly so as to expose a great portion of the synsacral neural crest.

The ischio-pubic fissure is closed in all three genera here described; the obturator foramen is shut off therefrom by a bony bar.

The pubis is long and straight, and projects beyond the level of the ischium, especially so in *Calyptomena*.

The close approximation of the post-acetabular ilium to the transverse processes of the free caudal vertebræ is due to the shortness of the transverse processes of the synsacral vertebræ already referred to.

The *fovea lumbalis* is small; and the *fovea ischiadica* and *pudendalis* are confluent.

viii. The Pectoral Limb.

The pectoral limb of the genera here described presents no marked differences by which they can be distinguished one from another.

It resembles that of the Coliidæ and Capitonidæ in that metacarpal II. sends backwards from its proximal end a small triangular bony spur (intermetacarpal process) to abut against

metacarpal III. In the Eurylæmidæ this spur is, however, much larger than in the Coraciiform genera referred to.

The humerus only is pneumatic; and is subequal to, or shorter than, the manus. The forearm is the longest segment of the limb. The *sulcus transversum* or coraco-humeral groove is shallow. The *crista superior* is triangular in form.

The *incisura capitis* is fairly sharply defined; the *fossa subtrochanterica* is large. There is a small ectepicondylar process, which, it is to be noted, is not forked as in the higher Passeres; the entepicondylar process is still smaller. Ventrad of the *tuberculum ulnare* is a prominent spur-like blunt-pointed tubercle directed backwards and outwards so as to interlock with the olecranon process of the ulna in the extended wing.

On the palmar surface immediately above the radial condyle is a small tubercle for the attachment of the inner head of the *extensor metacarpi ulnaris*.

The ulna has a prominent, pointed, olecranon process, and bears a row of small tubercles, for the attachment of the secondary remiges, along its postaxial border.

The radius is slender and slightly bowed. The forearm is the longest segment of the wing.

The manus is well developed. As in the Capitonidæ and the normal Passeres, the base of Mc. II. sends backwards a bony plate to overlap and fuse with the base of Mc. III. In the Eurylæmidæ this plate (intermetacarpal plate) is of considerable size, its base extending down the shaft for some distance.

In some Coraciæ, e. g. *Eurystomus*, there is also an intermetacarpal plate, but feebly developed, and not fused with Mc. III.

ix. The Pelvic Limb.

The pelvic limb, in the Eurylæmidæ, has, in common with the Cotingidæ, a syndactyle pes; and in this respect these two families resemble many of the Coraciiformes. None of the bones are pneumatic; in which respect the Eurylæmidæ differ from the Cotingidæ, which have a pneumatic femur, and resemble many of the Coraciidæ.

The femur is long and slender. The popliteal fossa is represented only by a shallow depression.

The tibio-tarsus has moderately well-developed ecto- and entocnemial crests and a long fibular crest. The shaft is curved first forwards, then inwards, so that the distal end thereof is markedly inflected. The extensor bridge is ossified. The intercondylar gorge is deep. The fibula extends to below the level of the middle of the shaft of the tibio-tarsus.

The tarso-metatarsus is moderately long. The hypotarsus is complex. The distal end of the shaft is flattened from before backwards, and laterally expanded to form the condyle for digits II.-IV. These condyles all extend forwards to practically the same level, the middle condyle scarcely projecting beyond the level

of those on either side. In section the shaft is subcylindrical. Mc. I. is long, as in the Passeres.

The pelvic limbs of the Eurylæmidæ and Cotingidæ can be distinguished from the limbs of the syndactyle members of the Coraciiformes by the fact that, in the latter, the tarso-metatarsus is either broad and flat, or deeply grooved anteriorly, and is more or less triangular in section. Further, the cnemial crests of the tibio-tarsus are, in the Coraciiformes having this type of feet, but feebly developed.

x. Summary.

Regarded, by common consent, as the most lowly of the Passeriformes, the Eurylæmidæ are at the same time an extremely specialised group; much more so than has been hitherto recognised. Such a condition might have been expected indeed, inasmuch as this is a common feature among primitive groups.

Nowhere is this specialisation more conspicuous than in the skull. The basipterygoid processes have entirely disappeared; the maxillo-palatines have been reduced from broad triangular plates to rod-like splints; and a singularly perfect fronto-nasal hinge has been developed. In some genera, as in *Corydon*, the beak has vastly increased in size, and has acquired a markedly hooked shape, as well as a great increase in breadth. Nor is this all. The vomer presents a number of gradations in the direction of reduction and degeneracy; and this is true also of the nasals, whereby the anterior narial fossa—which, by the way, is only in fact a narial fossa in so far as its extreme anterior end is concerned—is enormously enlarged. The lachrymal has been reduced to a mere vestige embedded, though still free, in the anterior face of the antorbital plate as in *Calyptomena*, or it is wanting as in *Corydon*. The palato-pterygoid articulation is also specialised; so too is the nature of the vomerine support, this having been transferred from the pterygoids to that of the palatines. The hemipterygoid element appears to be wanting, but traces of this may turn up in the nestlings of *Calyptomena*.

Evidence of yet further specialisation is obtained from a study of the nestling skull. Besides the disappearance of the hemipterygoid just referred to, the squamosal gives unquestionable proof in this direction; yet, at the same time, having preserved the essential characters of its shape, this element, more than any other bone in the skull, affords testimony of no uncertain kind as to the truly Passerine character of the group. Roughly ⊥-shaped, there can nevertheless be no doubt, from the general contours of the bone, that it has been derived from a larger and more conical plate resembling that which obtains in the Corvidæ for example. Further, as in all the Passeres, the long axis of this bone is continued upwards and forwards beyond the parietal so as, in short, to overlap the frontal. So far as I have yet been able to ascertain, such an extension does not obtain anywhere among the Coracii-

formes. A further indication of specialisation is the fact that the squamosal, in all the Passeriformes and most of the Coraciiformes, has absorbed the underlying bones so that it now appears, almost in its entirety, within the cranial cavity. The remarkable variations which obtain in the Class Aves, in the form and arrangement of the membrane-bones are of considerable interest. These changes seem to follow along certain definite lines, and are the more remarkable because, save for the first few weeks of the bird's life (the nestling period in short), these bones, as separate entities, cease to exist, being fused to form one homogeneous tissue. Yet progressive evolution is as obvious as in, say, the sternum or pelvis; though they cannot be individually influenced by the strains and stresses incident to the struggle for existence in the same way as if they maintained their individuality throughout life, or for at least some considerable time after leaving the nest. This is a point to which I propose to return later.

So far we have described only the specialised features of the skull; what of the primitive? It is difficult to speak with any degree of certainty on this point. The small size of the anterior, posterior, and superior tympanic recesses, and of the tympanic cavity, may be reckoned in this category; and so too, probably, should the long narrow vomer as seen in *Calyptomena*. The close approximation of the otic and squamosal heads of the quadrate is an undoubtedly primitive character. These, in the Eurylæmidæ, are barely separated; in the Corvidæ, for example, they are comparatively wide apart. These few points seem to sum up all the evidence that is obtainable on this question.

How far specialisation has gone in the skulls within this group may be seen at a glance by comparing the skull of *Calyptomena* with, say, that of *Corydon*. In the latter the antorbital plate is greatly reduced in size and thickness, and the lachrymal is wanting. The beak is markedly wider, more hooked, and articulates with the frontal by a more pronounced nasal hinge, while the nasal septum is obliterated by the inflation of the nasal processes of the premaxilla.

The simple, unforked condition of the spina externa of the sternum is undoubtedly a primitive character; and in the form of the pelvic girdle this group is less advanced than in the remaining Passeres.

Before proceeding to discuss the relationship of the Eurylæmidæ to the remaining Passeres, it would be well to say a few words as to the wider question, of the probable allies of the Eurylæmidæ outside the Passeres. This is a matter on which it is impossible to dogmatise; at most, one can but throw out suggestions, of a very nebulous character.

It will be found, probably, that Fürbringer (3) has come nearest to the solution of this problem. He points to a relationship between the Eurylæmidæ and the Cypseli, and a yet closer alliance with the Pici. Affinities to the Coraciidæ he regards as remote indeed.

My own work most certainly tends to support Fürbringer's conclusions. It is possible that the Eurylæmidæ will prove to be related both to the Caprimulgi and Cypseli. As regards the connection with the Pici, it is significant to note that the squamosal, in the nestling, closely resembles that of the Passerine type, inasmuch as it overlaps the frontal, an arrangement which does not appear to occur elsewhere among the Coraciiformes.

Coming now to the question of the relationship of the Eurylæmidæ to the remaining Passeres, I would remark, at the outset, that there seems scarcely sufficient ground for separating the former so widely from the latter as has been done by many during recent years. This separation foreshadowed by Garrod, and consummated by Forbes, has been widened even further than either of these distinguished workers would have considered justified.

Forbes, just twenty-five years ago (**2**), summarised the main features of the Eurylæmidæ, from the systematic point of view, as follows:—". . . . They are *not* Tracheophone; and in that they possess the sciatic instead of the femoral artery, they differ from the Pipridæ and Cotingidæ, with which they have so often been associated. From these, too, they differ, as they do from the Tyrannidæ, Pittidæ, and *Rupicola*, in the ***details**** of the syrinx as well as in the simple manubrium sterni and other points. As has already been stated, they differ from all the other Passeres in the retention of a vinculum in the deep plantars of the foot . . . ." In a second contribution to this subject during the same month these views were repeated. After referring again to the syrinx and syndactyle foot, he goes on to remark:—"The peculiarities of the Eurylæmidæ, and especially their oft-spoken-of retention of the plantar vinculum, are sufficient, I think, to justify their forming a main division of Passeres by themselves, as suggested by Prof. Garrod, which may be termed Desmodactyli, in distinction from the others, Eleutherodactyli . . ."

It seems to me open to question whether so wide a separation is justified.

After all, the existence, or rather we may say the survival, of the plantar vinculum is not so very surprising, not more so than the persistence of basipterygoid processes for example—which crop up sporadically among groups which have, as a whole, long since lost them. In *Calyptomena*, according to Beddard, this vinculum is wanting. Some importance has been given to the statement made by Forbes, that in *Eurylæmus ochromelas* there is a second vinculum: the additional slip "being given off lower down, from the hallux tendon, which joins the tendon of the digital flexor at the point where the latter, splitting into three, receives the main vinculum." Gadow (**4**), commenting on this statement, remarks that this arrangement closely agrees with what obtains in *Upupa* and *Irrisor*, a fact which suggests the origin of the Passerine plantars from this type.

* Italics mine.—W. P. P.

Though I looked carefully for this slip, I failed to find it, yet I examined three or four specimens.

Forbes showed that, in the matter of the syrinx, the Eurylæmidæ agree most nearly with the Philepittidæ of the Old World; and, after that, with the Cotingidæ, Pipridæ, and Tyrannidæ of the New World. This organ is of the "Mesomyodian," "tracheo-bronchial" type, or, to adopt Gadow's term, the syrinx is tracheo-bronchial and "Anisomyodean."

Had the syrinx instead of the plantar tendons been adopted as the basis of classification for this group, then the Cotingidæ would have been regarded as the more primitive group, inasmuch as in *Lipaugus cineraceus* the intrinsic muscle, according to Beddard, is of great width, "which seems to foreshadow its division in the Oscines into a complex of muscles . . . ."

The many characters which the Eurylæmidæ and Cotingidæ share in common—skeletal, muscular, syringeal, pterylological, &c.—are surely proofs that these two groups are much more nearly allied than is generally supposed to-day: the likenesses are too many and distinct to be put down to convergence or correlated variation.

The fact that the spina externa of the sternum is simple is generally bracketed together with the plantar tendons, and other characters, so as to emphasise the primitive character of the Eurylæmidæ. But this same peculiarity of the sternum occurs again in the Cotingidæ. The pterylosis of the Eurylæmidæ is generally regarded as peculiar: as a matter of fact, it is hard to distinguish from that of the Cotingidæ. The syndactyle foot again turns up—in the Cotingidæ. We have already described the close resemblances which obtain in the skulls of these two groups.

Turning now to the muscular system. The syringeal muscles we have already referred to. They offer no striking peculiarities of structure. Indeed, the only muscles which seem to call for comment in this summary are the *brevis* and *longus* divisions of the *deltoideus*. The separation of this muscle into two distinct parts is nowhere so complete as in the Passeres.

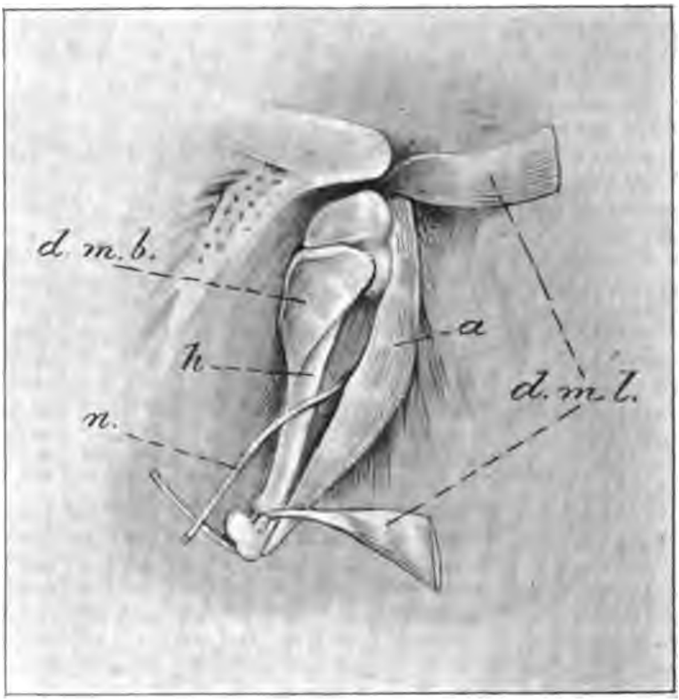
In its primitive (archicentric) condition, this muscle arises, in part from the acromion and inner face of the expanded free end of the clavicle and in part from the *os humero-scapulare* and *crista lateralis* of the humerus. It is inserted by a common tendon into the base of the ectepicondyloid process; the tendon forming the terminal of a practically homogeneous muscle.

I have not yet had time to study the apocentricities of this muscle, but it would appear that as specialisation proceeds it breaks up into two more or less equal and perfectly distinct muscles terminating in a common tendon: later the brevis portion becomes suppressed and the longus much shortened, each receding farther and farther up the shaft of the humerus.

I have only just realised the potentialities of this muscle as a factor in systematic work, and therefore have no large series of

data to support this interpretation. But the facts, in so far as they are relevant to the present paper, seem to show that the primitive (archicentric) condition is represented fairly well in, say, *Paradisea*. In *Corvus corax* the longus portion is degenerate and fuses with the brevis just below the middle of the shaft of the humerus, the brevis portion then running downwards, ultimately becoming tendinous and passing to its insertion at the base of the ectepi-

Text-fig. 15.



Dissection of arm, dorsal aspect, of *Eurylæmus ochromelas*, to show the *deltoideus major longus* and *brevis*. The longus portion has been cut through the middle, and the two halves drawn in opposite directions. The brevis portion has now become very degenerate and quite functionless.

d.m.b., deltoideus major brevis; *d.m.l.*, deltoideus major longus; *a.*, anconeus; *h.*, humerus; *n.*, nervus radialis.

condylar process. In *Sturnus* both portions are extremely well developed, and perfectly separate until the distal end is attained, where they fuse in a fleshy insertion in which may be traced two distinct incipient tendons.

In the Eurylæmidæ and Cotingidæ—at least in so far as *Rupicola* is concerned—the major portion is well developed, but the brevis portion has now receded, not extending beyond the middle of the humerus, and having an entirely fleshy insertion; the longus portion, on the other hand, is slender and terminates in a long tendon.

This interpretation of the transformations of the *deltoides major et minor*, it will be noticed, runs directly counter to that of Dr. Chalmers Mitchell, who, in a paper "On the Anatomy of Gruiform Birds" (6), contended that apocentricity in this muscle was shown by the gradual extension down the shaft of the major portion. It would seem, rather, as if the archicentric condition were represented by the maximum downward extension, and that apocentricity is represented by the gradual reduction of muscular tissue.

That this reduction and inevitable suppression of the brevis portion represents an extremely specialised condition there can be no doubt; and the fact that it is shared also by the Cotingidæ seems to me, coupled with the numerous other points which these two groups share in common, to show conclusively that the Eurylæmidæ and Cotingidæ must henceforth be regarded as very closely related forms.

These two groups differ in some other myological characters, as might be expected. The most noticeable is the fact that the *latissimus dorsi posterior* in the Cotingidæ appears to be wanting, though it must be remarked I have only been able to examine a single specimen of *Rupicola* in this connection. In the Eurylæmidæ both muscles are present, strap-shaped in form, and widely separated; therein differing from the Corvidæ, in which they are of considerable size and slightly overlap one another. But this feature is one of many primitive characters which the Corvidæ have retained.

The peculiar myological resemblances which these birds share do not necessarily imply relationship; but, as I have just remarked, there are so many structures in which these two groups agree, that it is impossible to entertain any notion of convergent resemblance between the two. The points of likeness are so peculiar, and affect such different, independent systems, that correlated variation and convergence cannot be regarded as a satisfactory explanation of the case. When two apparently convergent forms come to be particularised, each new point of resemblance which is brought to light is to be regarded as an additional link in the chain of evidence, establishing the common origin of the two forms in question.

Thus, then, I contend there is no evidence which will justify the present isolated position which has been almost universally assigned to this group during the last few years. It is quite possible that further investigation will show that the Eurylæmidæ are entitled to rank no higher than a subfamily of the Cotingidæ.

But this point, as well as the status of the "Passeres Clamatores," I propose to deal with in a further communication at no distant date.

xi. List of Literature referred to.

(1) Beddard, F. E.—The Structure and Classification of Birds.
(2) Forbes, W. A.—"Contributions to the Anatomy of Passerine Birds." Parts II., III. P. Z. S. 1880.
(3) Fürbringer, M.—"Zur vergleich. Anat. des Brustschultes-apparates." Jenaisch. Zeitschr. f. Naturwiss. xxxvi. 1902.
(4) Gadow, H.—Bronn's Thier-Reich. Systemat. Theil, Band vi. Vögel. 1893.
(5) Garrod, A. H.—"On some Anatomical Characters which bear upon the Major Divisions of the Passerine Birds." Part I. P. Z. S. 1876.
(6) Mitchell, P. C.—"On the Anatomy of Gruiform Birds." P. Z. S. 1901, vol. ii. p. 629.
(7) Sharpe, R. B.—A Review of Recent Attempts to Classify Birds. 1891.

xii. EXPLANATION OF PLATE II.

Fig. 1. Inner aspect of skull of nestling *Eurylæmus* showing the large area occupied by the squamosal.

1 *a*. Outer view of same skull showing the peculiar form of the squamosal.

2. Side view of *Calyptomena viridis* showing the peculiar lachrymal, large narial aperture, and large and spongy antorbital process.

2 *a*. Ventral view of same skull to show the vomer, maxillo-palatine processes, and wide-set palatines.

2 *b*. Dorsal aspect of same skull to show the large size of the nasal fossa and the nasal hinge.

3. Ventral aspect of skull of *Cymbirhynchus* showing the slender maxillo-palatine processes, short vomer, and sharply bent palatines. Note the difference between the palatal surface of this species and that of *Calyptomena*.

3 *a*. Dorsal aspect of same skull to show the closing in of the nasal fossa and the formation of pseudo-nasal apertures.

4. Dorsal aspect of the skull of *Corydon* to show the large size of the narial apertures and nasal hinge.

Explanation of Letters.

a.o.p. = antorbital process.
als. = alisphenoid.
a.p.v. = anterior palatine vacuity.
b.oc. = basi-occipital.
b.s. = basisphenoid.
ex. = exoccipital.
fr. = frontal.
h.pt. = hemipterygoid.
l. = lachrymal.
mes. = mesethmoid.
mx.p. = maxillo-palatine.
na. = nasal.
n.h. = nasal hinge.
p. = parietal.
pa. = palatine.
p.na. = posterior nares.
p.o.p. = postorbital process.
pro. = prootic.
pt. = pterygoid.
s.n. = septum nasi.
sq. = squamosal.
v. = vomer.

May 16, 1905.

G. A. BOULENGER, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in April 1905:—

The registered additions to the Society's Menagerie during the month of April were 205 in number. Of these 67 were acquired by presentation and 19 by purchase, 104 were received on deposit, 9 by exchange, and 6 were born in the Gardens. The total number of departures during the same period, by death and removals, was 126.

Amongst the additions special attention may be directed to:—

A young female Chimpanzee (*Anthropopithecus troglodytes*), deposited on April 8th.

A young female Giraffe from Northern Nigeria, probably belonging to the race known as *Giraffa camelopardalis peralta*, purchased on April 7th.

A young male Huanaco (*Lama huanacos*), from Punta Arenas, Tierra del Fuego, presented by Mr. Moritz Braun and Capt. R. Crawshay on April 10th.

A pair of Concave-casqued Hornbills (*Dichoceros bicornis*) from India, purchased on April 4th.

Mr. Oldfield Thomas, F.R.S., exhibited examples of a new Golden Mole from Knysna, Cape Colony, which had been obtained by Mr. Grant in connection with Mr. C. D. Rudd's exploration of South Africa, and which he proposed to name in honour of Mrs. Rudd, who had taken much interest in the results of the exploration.

AMBLYSOMUS CORRIÆ Thos.*, Abstr. P. Z. S. No. 20, p. 5, May 23, 1905.

Rather smaller than *A. hottentottus*. General colour dark smoky blackish, darker than in *A. iris*, with a beautiful iridescent sheen, greenish to coppery violet, over the whole upper surface. Sides and belly not or scarcely lighter, a slight brownish tone occasionally present along the centre of the abdomen. Hairs of back 8–9 mm. in length, their bases dark slaty grey, their ends lighter and more brownish grey subterminally and their tips iridescent blackish brown. Crown and forehead like back. Cheeks paler, greyish or yellowish, but not conspicuously contrasted. Limbs and upper surface of hind feet smoke-grey.

Skull (Pl. XVI. † fig. 3) in its general characters like that of

* [The complete account of the new species described in this communication appears here; but since the name and preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—EDITOR.]

† P. Z. S. 1905, vol. i. p. 254.

A. hottentottus, but markedly narrower across the brain-case; and the zygomata less thickened at their posterior base. As a result, the two skulls being of about the same length, the general outline was much less broadly triangular. Muzzle and interorbital region narrow and delicate.

Outer edge of permanent teeth narrow antero-posteriorly, and of milk-teeth broad with conspicuous cusps, as shown in the Plate. The anterior premolar triangular, not extended transversely as in *A. obtusirostris* and *chrysillus*.

Dimensions of the type, measured in the flesh:—Head and body 129 mm.; hind foot 13.

Skull—greatest length 28, basal length 22·6; greatest breadth across brain-case 16·6; greatest height 12·6; interorbital breadth 8; front of i^1 to back of m^3 10·5; palate, breadth across premolars 8·1.

An adult female had a head and body length of 118 mm.; greatest skull length 25·7.

Hab. Knysna, S. Cape Colony. "In Forest."

Type. Old male. Original number 1021. Collected 25 January, 1905, by C. H. B. Grant, and presented to the British Museum by Mr. C. D. Rudd. Ten specimens examined.

This handsome little species was not only a very interesting discovery in itself, but the fine series of it obtained by Mr. Grant, of both sexes and different ages, had enabled Mr. Thomas to identify with confidence the milk and permanent dentitions of the specimen figured in the plate illustrating his paper on the Zululand Mammals collected by Mr. Grant. No proper knowledge of the respective characters of the two dentitions had hitherto existed.

Mr. H. B. Fantham, B.Sc., F.Z.S., exhibited microscopic slides of and made remarks upon *Lankesterella tritonis*, n. sp., a Hæmogregarine parasitic in the red blood-corpuscles of a Newt, *Triton cristatus* (*Molge cristata*). Blackboard sketches were made illustrating the life-history of the parasite so far as was known.

This parasite was found some time ago by the exhibitor while working in the Zoological Laboratory, University College, London. Afterwards his observations were independently confirmed by Dr. A. C. Stevenson. Up to the present the trophozoite and schizogonous stages only had been seen, and the sporogony probably took place in an intermediate host. Schaudinn's and Siegel's recent observations on the sporogony of allied parasites in the lizard and water-tortoise were quoted in support of this view, and mention was made of the inaccuracy of Hintze's account of the sporogony of *L. ranarum* in the intestine of the frog, the cysts therein mentioned probably being Eimerian stages of a Coccidian.

The trophozoites, vermiform in shape, were apparently 5 μ to 6 μ in length, and slightly over 1 μ broad. They became U-shaped

and gave rise to "rosette-stages," about 2·5 μ to 3·5 μ in diameter. A "rosette" consisted of a schizont dividing up into merozoites.

This parasite was probably the smallest Hæmogregarine yet described, and it occurred in large red blood-corpuscles, those of *Triton cristatus* being about 30 μ in long diameter. The research on this parasite and allied forms was being continued.

The following papers were read:—

1. A Contribution to the Knowledge of the Encephalic Arterial System in Sauropsida. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received March 29, 1905.]

(Text-figures 16–21.)

The following pages contain some facts relating to the principal vessels of the arterial system of the brain in a number of Lizards, in a Python, and in the giant Tortoise, *Testudo vicina*. Some of these have not been hitherto studied; some have been examined by Rathke and others, and references to these anatomists will be found in the proper place. Most of the brains which I describe are now in the Museum of the Royal College of Surgeons. My principal object has been, next to the recording of new facts, to ascertain how far the characters offered by the distribution of these vessels, which are undoubtedly of use in the systematic arrangement of mammals, are also of use in the remaining Vertebrata for a like purpose.

§ *Brain of* Varanus exanthematicus.

Although the cerebral arterial system of *Varanus griseus* has been described by Corti*, I have a few notes to add to his description and comparisons to make with the other genera treated of in the present communication.

The two vertebral veins are strong and mark the posterior end of the medulla, precisely as is the case with *Iguana*. The posterior pair of cerebellar arteries arise, as in *Iguana*, from the basilar artery at the middle of the medulla, and are larger than the anterior pair, which arise from the fork of the basilar in front. This fork is not quite so symmetrical as in *Iguana*. The left side and the left carotid are rather thicker than the right, and there is thus a suggestion of the marked inequality of these arteries in *Python*. The branches to the corpora bigemina and to the rest of the brain are quite as in *Iguana*; but the large size of the ophthalmic arteries is a point of likeness to *Python*.

* De systemate vasorum *Psammosauri grisei*. 1853.

§ *Brain of* Iguana tuberculata.

The plan of the cerebral arteries in this Lizard differs in a number of particulars from that which will be shortly described. The anterior spinal artery, though of considerable size, is yet of less calibre than the basilar, with which it is nevertheless in perfect continuity. The exit of the posterior pair of cerebellar arteries marks the middle of the medulla. These arteries are slightly asymmetrical, the left being a little in advance of the right. They arise behind the point of origin of the 6th pair of cranial nerves. The anterior pair of cerebellar arteries arise just after the division of the basilar artery to form the carotids on each side; they are distinctly smaller than the posterior pair.

The two branches of the basilar are approximately equal in size, as are the carotids which join them very shortly after the bifurcation of the basilar. The point of junction is just at the point of origin of the anterior cerebellar arteries. In this, it will be observed, is a slight difference from the figure of the cerebral arterial system of this Lizard given by Rathke *. The next artery arising from the circle of Willis is in front of the third nerve (to the inside of which nerve passes the forward continuation of the carotid, as in other vertebrates) and supplies chiefly the corpus bigeminum of its side; but it also gives off a branch each to the cerebellum and to the cerebral hemisphere. A little way anterior to this is a much more slender vessel which is absolutely symmetrical on both sides of the body and which almost at once divides into two branches; one of these ends upon the infundibulum, the other reaches the optic nerve of its side. Beyond this again arises the posterior cerebral artery. This artery reaches the hemisphere just at the furrow which divides it from the corpus bigeminum and runs parallel to the cerebral branch of the bigeminal artery.

A little further forward the carotid finally divides into two arteries. The outer and stronger branch may be termed the middle cerebral; it runs forwards, curving outwards in the middle so as to be crescent-shaped, to the long and slender olfactory bulbs, giving off numerous slender branches to the hemisphere on its way. The inner branch very soon again divides into two: the innermost of them is the ophthalmic artery; the outer runs forward along the median ventral line of the brain in close contact with its fellow of the opposite side.

* "Untersuchungen über die Aortenwürzeln &c. der Saurier," Denkschr. k. Akad. Wiss. Wien, xiii. 1857, p. 51.

[Since this paper was read Mr. R. H. Burne has kindly directed my attention to a paper by Dr. Hofmann in Zeitschr. f. Morph. u. Anthr. ii. 1900, in which the arterial system of the brain is described in a number of Fishes, Amphibia, Birds, and Mammals, and in the following Reptiles, viz. *Iguana*, *Tropidonotus natrix*, Crocodile, and *Testudo græca*. That of the last alone (among Reptiles) is figured. This paper has been apparently overlooked by the recorders of the Mammalia, Aves, and Reptilia in the 'Zoological Record' for 1900; but it is catalogued by the recorder of 'General Subjects."—*July 6th.*]

§ *Brain of* Tropidurus hispidus.

In comparing the arterial system of the brain of this Iguanoid with those of the other species of Lacertilia with which I have dealt, I am unable to say anything about the cerebellar arteries, which were not visible in the specimen examined by me. The bifurcation of the basilar artery in front at rather an acute angle consisted of equally-sized vessels, and the carotids which joined these arteries behind the third pair of nerves were also equal. The arteries to the corpora bigemina disappear at once in the groove separating each corpus bigeminum from the hind brain. The other arteries of the brain seem to be as in other Lacertilia.

§ *Brain of* Eumeces algeriensis.

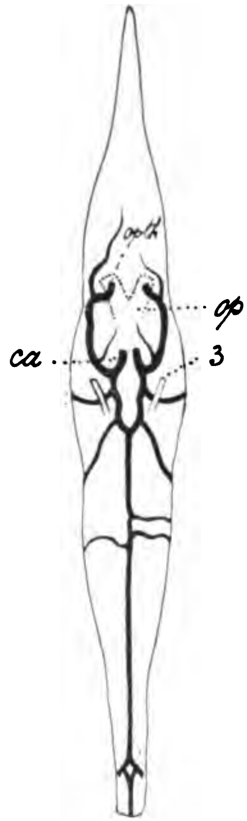
The arrangement of the arteries of the brain in this Skink, which, so far as I am aware, has not been described, shows certain differences from that of both *Varanus* and *Iguana*. These features are illustrated in the accompanying drawing (text-fig. 16, p. 62). The fusion of the vertebral arteries with the basilar marks, as is usual, the end of the medulla. From the basilar artery arise a number of branches of which the posterior cerebellar arteries are the most important; of these the left artery arises in advance of the right and it is shortly reinforced by another branch. The bifurcation of the basilar anteriorly begins further back than in both *Varanus* and *Iguana*; and another difference from the conditions observable in these two genera is to be noted. In these Saurians the carotids join the circle of Willis behind the origin of the third pair of nerves; in *Eumeces* these arteries join the circle of Willis well in front of the third nerves, and therefore also in front of the slender anterior cerebellar arteries, and of the artery supplying the corpus bigeminum on each side. This artery not only supplies the corpus bigeminum but also the cerebellum, and it sends a branch forward which runs parallel to the posterior cerebral artery, and like it is lost in the groove separating the fore brain from the mid brain. Between this artery and the middle cerebral or Sylvian is a slender twig like that of *Iguana* which runs to the base of the optic nerves. The anterior cerebral, which gives off the ophthalmic artery, is considerably thicker than the middle cerebral artery.

§ *Brain of* Gerrhosaurus.

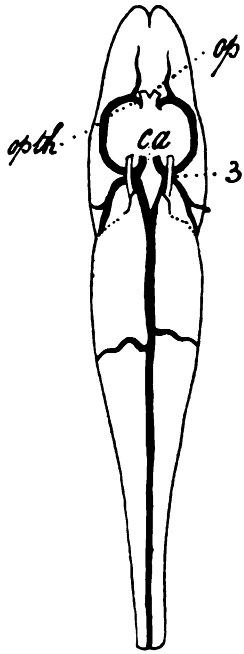
As is the case with *Eumeces*, the basilar artery in *Gerrhosaurus* (see text-fig. 17, p. 62) divides rather further back than it does in either *Iguana* or *Varanus*. There is, moreover, a very distinct inequality of calibre in the two arteries; the right is in fact considerably larger than the left. This inequality does not, however, extend to the two carotids, which are equal in size. These join the circle of Willis only just in front of the point of origin of the anterior

cerebellar arteries, which latter, as in other Lizards, are smaller than the posterior pair. The place at which the carotids join the circle of Willis is only just behind the third pair of cerebral

Text-fig. 16.



Text-fig. 17.



Text-fig. 16.—*Eumeces algeriensis.* Ventral aspect of brain, showing chief arteries. *ca.* Carotids; *op.* Optic nerves; *opth.* Ophthalmic arteries: 3, third nerves.

Text-fig. 17.—*Gerrhosaurus flavigularis.* Ventral aspect of brain, showing chief arteries. Lettering as in text-fig. 16.

nerves. The order in which the remaining arteries of the brain arise is quite similar to that of the other Lizards described here, and there are no particular comments to be made upon them.

§ *Brain of* Tupinambis nigropunctatus.

The most important branches arising on either side from the

basilar artery are the posterior cerebellar, and these arise a little behind the middle of the medulla. The two arteries are perfectly symmetrical with each other as to their point of origin. They are, however, different in their branching. The right artery gives off, shortly after its origin from the basilar, a strong artery running backwards along the side of the spinal cord. This branch exists and pursues the same course on the left side; but on that side of the brain it arises separately from the basilar artery. Between the origin of the posterior cerebellar arteries and the bifurcation of the basilar anteriorly are three pairs of small arteries supplying adjacent regions of the medulla. A slightly larger artery, which is the anterior cerebellar, arises from the fork of the basilar. This fork is U-shaped in the Teguexin (text-fig. 18, p. 65), and not V-shaped as in the other Lizards described here. The U-shape is due to the fact that the two carotids run parallel to and almost in contact with each other for some distance before they join the circle of Willis. The carotids, moreover, lie within the area bounded by the third nerves very close to and about on a level with those nerves. The artery formed by the junction of the basilar and carotid on each side, often spoken of merely as the carotid, passes outwards and slightly backwards at first, when it is practically at right angles with the basilar. In this region the artery shows different relations on the two sides of the body. On the left side it runs in front of the third nerve; on the right side it lies behind that nerve. The first branch arising after the carotid is at the bend of the artery, where it turns forward; this very stout artery supplies the cerebellum and optic lobe; immediately in front of this is the artery of the optic lobe. This state of affairs occurred on the left side of the body; on the right side the two arteries arose by a common trunk. On both sides the artery of the corpus bigeminum gives off an artery to the cerebral hemisphere which buries itself in the furrow between the hemisphere and the optic lobe. From the inner side of the circle of Willis, just opposite to the bigeminal artery on the left side and to the conjoined arteries just mentioned on the right side, arises an artery which runs to the optic chiasma. This artery is precisely like that of other Lacertilia. The next artery to be given off is the posterior cerebral, which plunges at once into the furrow lying between the optic lobe and the cerebral hemisphere. The middle cerebral artery, which is the largest of the cerebral arteries, runs in the usual way along the Sylvian depression, and just in front of the point of origin of this the circle of Willis practically ends in the strong ophthalmic arteries which follow the optic nerves. There are therefore no differences of importance between the arterial system of the brain of *Tupinambis* and of the other genera of Lizards reported upon in the present communication.

§ *Cerebral Arteries in the Lacertilia.*

We may deduce from the facts just described the chief

characters of the encephalic arterial system in the Lacertilia for purposes of comparison with those of other Vertebrates *.

(1) The entrance of the vertebral arteries into the anterior spinal marks the end of the medulla oblongata.

(2) The posterior cerebellar arteries are the only conspicuous arteries arising from the basilar; they arise at about the middle of the medulla oblongata and behind the 6th pair of cranial nerves; they are occasionally asymmetrical with each other.

(3) The anterior bifurcation of the basilar is at a more or less acute angle according to its position; the slender anterior cerebellar arteries are invariably given off from the bifurcated basilar behind the point of origin of the third nerves; the two branches of the basilar produced by the bifurcation may be inequisized.

(4) The point of entrance of the carotids is not invariably the same; it is sometimes in front of and sometimes behind the third pair of nerves.

(5) The artery on each side to the corpus bigeminum sends branches to the cerebellum and to the cerebral hemispheres. It arises in front of the entrance of the carotids.

(6) In front of this artery is one which runs towards the optic chiasma.

(7) There are three cerebral or hemispheral arteries: the posterior reaches each hemisphere just at its junction with the corpus bigeminum; the middle one is Sylvian in position; the anterior cerebral gives off the ophthalmic; there is no distinct completion of the circle of Willis anteriorly.

(8) There is no strongly marked asymmetry in the cerebral arterial system of the Lacertilia.

§ *Brain of* Python molurus †.

I have been able to study two injected brains of this serpent, of which one is more completely injected than the other. The most obvious and plain difference from the brains of other Sauropsida is the marked asymmetry in the arterial system (text-fig. 19, p. 65), which agrees of course with the vascular asymmetry shown elsewhere among the Ophidia. This asymmetry, however, only concerns the carotids. The other arteries of the brain, so far as I have been able to study them, do not show anything of the kind, but indeed a perfect regularity quite comparable to that shown in other Sauropsida. Of the two carotids the left is very much the larger. The basilar artery is single where it runs along the ventral surface of the cord and brain, until of course it bifurcates anteriorly at the commencement of the circle of Willis. The entrance of the vertebral arteries marks the end of the medulla. These arteries, which lie exactly opposite to each other, are very much stouter than the basilar, which they combine with the anterior spinal to

* See below, pp. 66, 67, and 69, for comparison with Ophidia and Testudinata.

† Rathke describes but does not figure brain-arteries of Ophidia in Denkschr. Akad. Wiss. Wien, xi. 1855.

form. In one of the two specimens at my disposal, I could not see very well the actual mode of junction of the vertebral arteries with the basilar. In the other it was plain and very complicated. The basilar artery itself divides and immediately reunites, thus forming a circle; the two vertebrals join below this circle, and from the lower surface of this transversely running trunk two

Text-fig. 18.

Text-fig. 19.

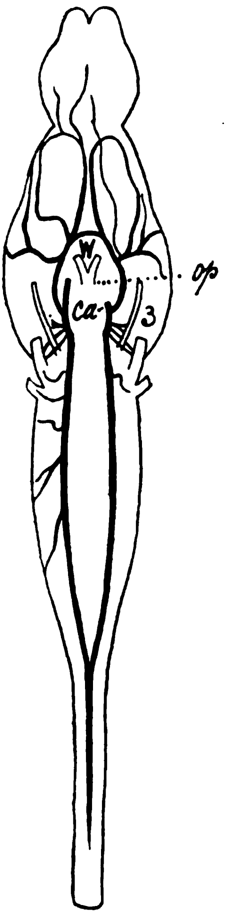
Text-fig. 18.—*Tupinambis nigropunctatus*. Ventral aspect of brain, showing chief arteries. Lettering as in text-fig. 16.

Text-fig. 19.—*Python molurus*. Ventral aspect of brain, showing chief arteries. *v*. Vertebral arteries. Other letters as in text-fig. 16. To the right of the figure is an enlarged representation of the junction of the vertebral arteries with the basilar.

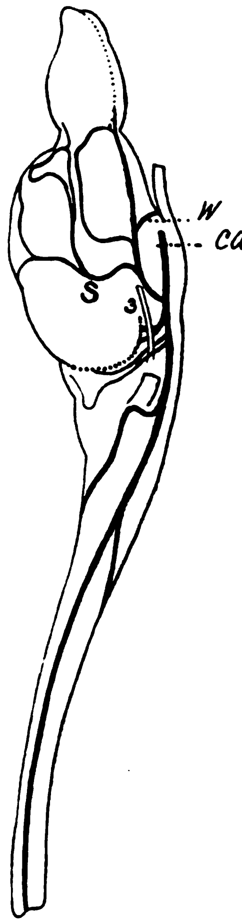
branches are given off, each of which joins one side of the circle already referred to. I should not like to lay undue stress upon the fact as absolutely characteristic of *Python*, since the arrangement was not obvious in one specimen through deficiency of injection.

cerebral artery arises from the circle of Willis a very short way in front of the Sylvian artery. This vessel runs forwards parallel

Text-fig. 20.



Text-fig. 21.



Text-fig. 20.—*Testudo vicina*. Ventral aspect of brain, showing chief arteries. *w*. Junction of two halves of the circle of Willis anteriorly. Other lettering as in text-fig. 16.

Text-fig. 21.—*Testudo vicina*. Lateral aspect of brain, showing chief arteries. *S*. Sylvian. *w*. Junction of two halves of the circle of Willis anteriorly. Other lettering as in text-fig. 16.

with and close to the olfactory branch of the Sylvian, and finally ends in an anastomosis with the main stem, from which the

far forward as compared with the Lacertilia; but this appearance is at least partly due to the great length of the bifurcate region of the basilar artery in *Python* as compared with that of any Lacertilian.

(5) The artery to the corpus bigeminum on each side arises behind the entrance of the carotid instead of in front as in Lacertilia. It gives off branches to the cerebrum and also to the cerebellum.

(6) In front of this artery and also in front of the carotid is an artery which runs towards the optic chiasma.

(7) There is a very marked completion of the circle of Willis anteriorly.

(8) There is a strongly marked asymmetry in the arterial system of the brain due to the greater size of the left carotid.

§ *Brain of* Testudo vicina.

The most salient characteristic of the arterial system in this Reptile is the double basilar artery (text-fig. 20, p. 68). The artery is double for the whole of its course beneath the medulla oblongata. The anterior spinal artery in fact divides into two well behind the medulla. The right-hand one of the two branches is not larger than the left; the two arteries do not run close side by side, but are separated by a considerable distance. They are joined each of them by the carotid in front of the origin of the third nerve. Behind the origin of the third nerve a large number of arteries arise from the basilar on each side; there are certainly eight or nine of them on each side, and they supply the cerebellum, the medulla, and the cranial nerves of this region of the brain. The fifth artery (on the right side at any rate), which arises from the basilar behind the third nerve, is *par excellence* the cerebellar artery; it fuses with its fellow of the opposite side at the end of the cerebellum. In front of the third nerve arise two arteries rather close together, of which the anterior has several branches and is the larger artery: it partly supplies the cerebral hemispheres and corresponds, as I imagine, to that artery in the Lacertilia which supplies the corpus bigeminum on each side.

As in the Lacertilia, there are two cerebral arteries on each side. The first and largest of these (text-fig. 21, p. 68) may be termed the Sylvian, as it runs along the lateral groove upon the hemisphere which has been compared to the Sylvian fissure of mammals The branches of this artery are not altogether symmetrical on the two sides of the body; it is possible, however, to distinguish the main trunk which runs towards the top of the brain, where it divides into a forwardly running and a backwardly running branch, several branches from the main stem which pass backwards over the temporal region of the hemisphere, and a strong branch running forwards to the olfactory lobe. Moreover, there is plain on one side a branch arising immediately after the origin of the Sylvian artery, which plunges at once beneath the hemisphere. A second

reptiles. And it must be admitted at once that the facts dealt with in the present communication do not conform with any certainty to one view or to the other. On the whole, however, they seem to point to the Lacertilian; since from that type the remaining schemes of encephalic arterial arrangement can be derived, while the extraordinary modification of the basilar artery in *Testudo*, found nowhere else, would seem for that very reason to be a divergence from the original condition.

2. On the Nomenclature of the Anthropoid Apes as proposed by the Hon. Walter Rothschild. By Sir H. H. Johnston, G.C.M.G., K.C.B., F.Z.S.

[Received May 5, 1905.]

I should like to make a few remarks on the admirable paper written on this subject by Mr. Walter Rothschild, which has just appeared in the 'Proceedings' (1904, vol. ii. p. 413). Unfortunately, I did not know that this paper was going to be read in December 1904, or I should have endeavoured to be present. I am disposed in a general way to agree with Mr. Rothschild's classification of the great Apes of Africa. I have only one criticism to offer with respect to the nomenclature of the Chimpanzees. Since Mr. Rothschild has done so much to revise, revive, and establish the nomenclature of these Apes, I should like to see him introduce a more rational spelling into the third of his species of Chimpanzees—the Bald Chimpanzee, which he gives, following Du Chaillu, as *Simia koolookamba*. Du Chaillu was very inaccurate in his transcription of African words, and he used the cumbrous system of English transliteration which prevailed until the rational spelling was introduced thirty or forty years ago by various scientific societies and departments of the Government. *Koolookamba* is really two words, which are pronounced nkulu-nkamba. I think that this spelling might stand in preference to *Koolookamba* [*Simia nkulunkamba*].

A much more serious point, however, is the generic name which Mr. Rothschild gives to the Orangs—*Pongo*. Mr. Rothschild is undoubtedly right in reviving *Simia* as the most appropriate and the earliest name for the Chimpanzee genus, to which it was applied in the first instance by Linnæus. Linnæus evidently thought that the differences between the Chimpanzee and the Orang, which animal was later brought to his notice, were not more than specific, so that he included the Orang in the Chimpanzee genus. Much later, in 1799, Lacépède applied the generic name *Pongo* to the Orangs; and although in the same year the Orang genus was named *Satyrus*, Mr. Rothschild prefers *Pongo* to this very appropriate designation, and wishes to establish *Pongo* as the generic name for the Orangs. I would certainly protest against this. There is much to connect the Satyr of the Classical world and Mediæval mummeries with traditions of a red-haired man-of-

the-woods—the Orang—which had filtered to Europe through India and the Levant, and the Arab sea-borne trade from Sumatra; but *Pongo* is an African word originally applied to the Chimpanzee, and in all probability derived from the Bantu dialects of Angola, south of the Congo. The proper spelling of this word is Mpongo, and it is a root which, in varying forms, is found in a number of Bantu dialects and languages in Western and Equatorial Africa, and used to indicate either a chimpanzee or a big baboon *. I have not got access to various old books at the time of writing, but I think I am correct in saying that English and Dutch travellers on the West Coast of Africa in the 16th, 17th, and 18th centuries referred to the Chimpanzee as "Pongo." I also fancy that the same allusion and the same name are made use of by Buffon. As in zoological nomenclature the preference is for the adoption of a Latin or Greek name, it is a pity to introduce into our lists a barbarous word in preference to one derived from either of the classical languages. But when in addition an *African* word is taken as the name of an *East Asiatic* genus, then the choice is singularly inappropriate.

* It may be of interest to add the names for "Chimpanzee" in a number of African languages, mostly collected by myself:—

LANGUAGE.	DISTRICT.	WORD FOR CHIMPANZEE.
Temne	Sierra Leone	Ka-fuka (Ka- is *sing.* prefix).
Vai	Western Liberia	Ibulu.
Busi	North-western Liberia	Guru.
Mandingo	North of Sierra Leone, Liberia, and Ivory Coast.	Iburu.
Kpwesi	Central Liberia	Ibulu.
Gora	St. Paul's River, West Central Liberia.	Onyi.
Basā and *Dō*	Coast of Central Liberia	Ibĕ.
Kru and *Grebo*	Southern Liberia	Tuāwĕ
Yoruba	Interior of Lagos	Obō.
Ijō languages	Brass, Bonny, Niger Delta	Tele.
Ibo	Lower Niger	Ozodimba.
Efik	Old Calabar	Idiōk.
Umon, Ikun, and *Akuna-kuna*	Lower Cross River	Enōp or Enōwi.
Nki	Extreme Upper Cross River	Bôki.
Mbudikum	Sources of Cross River, N.E. of Cameroons.	Apū or Epfū.
Barondo and *Isubu*	North Cameroons Coast	Ewaka.
Mpongwe	Gaboon	Ntyege and Nchego; also Nkulu.
Kongo	Lower Congo and Congo Coast	Mpongi.
Kimbundu	Angola (south of Lower Congo)	Mpongo. [*** The origin of the name "Pongo," of Buffon and others.]
Kiwemba [or *Bemba*]	South-west of Tanganyika	Koroe.
Ki-guha	West Tanganyika	Tôlue.
Kabwari	North-west Tanganyika	Sôkô.
Manyema	West of Tanganyika and extreme Upper Congo.	Soko.
Ruanda	North of Tanganyika	Enjangwe.
Kifipa	East Coast, Tanganyika	Isike.
Lu-ganda	West and North Coast of Victoria Nyanza.	Edzike or Izike.

I do not suppose much deference will be shown to my own suggestions; but it seems to me that the best generic name for the Orangs would be *Satyrus*; or, if that is strongly objected to because it may be confused with the specific name of one or two Chimpanzees, then possibly *Pithecus*.

I cannot help thinking that in this case, as in many other instances, when we are settling for good and for all our biological nomenclature, we carry too far the passion for asserting the prior rights of the first invented name, which is occasionally a singularly inappropriate one.

I will conclude my paper with a few remarks on the definite knowledge of the different species of Anthropoid Apes from the dawn of zoological science in Greece to the end of the 18th Century of the present era, by which time European zoologists had begun to discriminate pretty clearly between the Gibbons, the Orang, and the Chimpanzee. Knowledge of the Gorilla of course was not clearly defined till about 1848 or even later. It is possible, however, that a living specimen of the Gorilla was brought over to Holland in the latter part of the 17th Century. A figure of this creature (which was a female) is given in Dr. Tyson's work on the Chimpanzee, published in London in 1699.

Aristotle, writing in about 330 B.C., divided the mammals that were nearest to man into three closely allied groups: the Pithekoi or Apes, the Keboi or Monkeys, and the Kunokephaloi or dog-faced Baboons. In the Latin translations of Aristotle these designations are rendered Simia, Cebi, and Canicipes. Aristotle's

LANGUAGE.	DISTRICT.	WORD FOR CHIMPANZEE.
Nyoro and *Hima* dialects.	Unyoro, Toro, Ankole, and south-west of Victoria Nyanza.	Isike, Yisiki, Echikuya, Empundu, Kitera.
Konjo	Mt. Ruwenzori	Ekitera.
Lihuku	Forest, north-west of Semliki River (Mboga Country).	Ngule.
Kibira	Congo Forest between Semliki R. and Upper Congo (Aruwimi basin).	Kika.
Mangala and allied languages.	Upper Congo, between Aruwimi and confluence of Mubangi Welle, and between course of Congo and vicinity of Welle River.	(Mu) Kumbuso (Mu- is only the singular prefix).
Lendu	West of Albert Nyanza	Ngrrr (r's trilled).
Bambute pygmies	Semliki-Aruwimi Forest	U'u.
Momfu	North-east Borderlands (Congo-Nile water parting) of Congo Forest, west of Lendu.	Tato.
Aluru	North of Albert Nyanza	Bim.
Madi	(Western dialects of) West of Mountain Nile, north-east of Congo Forest.	Arugu.
Makarka (Nyamnyam).	Southern and Western parts of Bahr-el-Ghazal province of Egyptian Sudan.	Baham *or* Bamu; also Iraugba and Nderuma.
Mundu	North-east of Makarka	Angó.
Bongo	North-west of Makarka	Dedda.

[Perhaps other travellers and philologists can fill up the gaps in this series of names.]

general description of the Pithekoi delineates very distinctly an Anthropoid Ape, and reads as though it was derived from a generalised knowledge of the Chimpanzee, a knowledge obtained no doubt from specimens which had been brought down the Nile from the Egyptian Sudan (in the southern parts of which the animal still exists) to Lower Egypt. A good summary of Aristotle's description of the Pithekoi is given in Dr. Tyson's celebrated book "On the Anatomy of a Pygmie, *sive Homo sylvestris*," which, as before stated, was published in 1699, and of which there are copies in two or three of the principal libraries of London.

I think I am correct in saying that in an Egyptian fresco or papyrus which is exhibited in the Egyptian collection of the Museum at Naples, a Chimpanzee is depicted amongst other strange animals brought to Egypt from the Sudan. I believe also there is a representation of the Chimpanzee on one of the Roman mosaics recently brought to light at or near Carthage, and now preserved in one of the Museums, either at Carthage or Tunis.

The Byzantine Greeks, who, after Alexander's conquests, extended their trade to India, and the Arabs of west, south, and east Arabia, who maintained commercial relations with Sumatra, the Malay Peninsula, North-west Borneo, and the ports of the Persian Gulf and the Red Sea, may have introduced some knowledge of the Orang utan to Constantinople, to Egypt, and to the Mediterranean world between 100 B.C. and the fall of the Byzantine Empire.

Sir Walter Scott in his novel 'Count Robert of Paris' introduced somewhat fantastically a captive Orang utan into the story. I am not aware what foundation he had for this incident; and I think it somewhat improbable that an Orang utan could at that period have survived the overland journey from the Persian Gulf to the Mediterranean, or the transit through Egypt.

Marco Polo, the Venetian, in 1296 or thereabouts, travelled overland from Asia Minor to China and the Malay Peninsula, and reached Sumatra and possibly Borneo, bringing back with him stories of man-like apes, some of which certainly referred to the Gibbons, while one or two may be attributed to the Orang utan.

Odoric, a friar of the Order of St. Francis, travelled overland from Constantinople to India during the first half of the 14th Century, and from India reached Sumatra by sea. He brought back distinct accounts of both Gibbons and Orangs.

Ibn Batuta, a Morocco Arab, also journeyed to those parts about the same time, and described the Orang utan in his records.

Friar Giovanni dei Marignolli, a Franciscan like Odoric, also travelled overland from France to China and thence to the Malay Archipelago during the first half of the 14th Century, and brought back from Sumatra, or more likely North Borneo, very distinct accounts of the Orang utan.

At the commencement of the 16th Century the Portuguese conquistadores reached Malacca and Sumatra in their ships, and

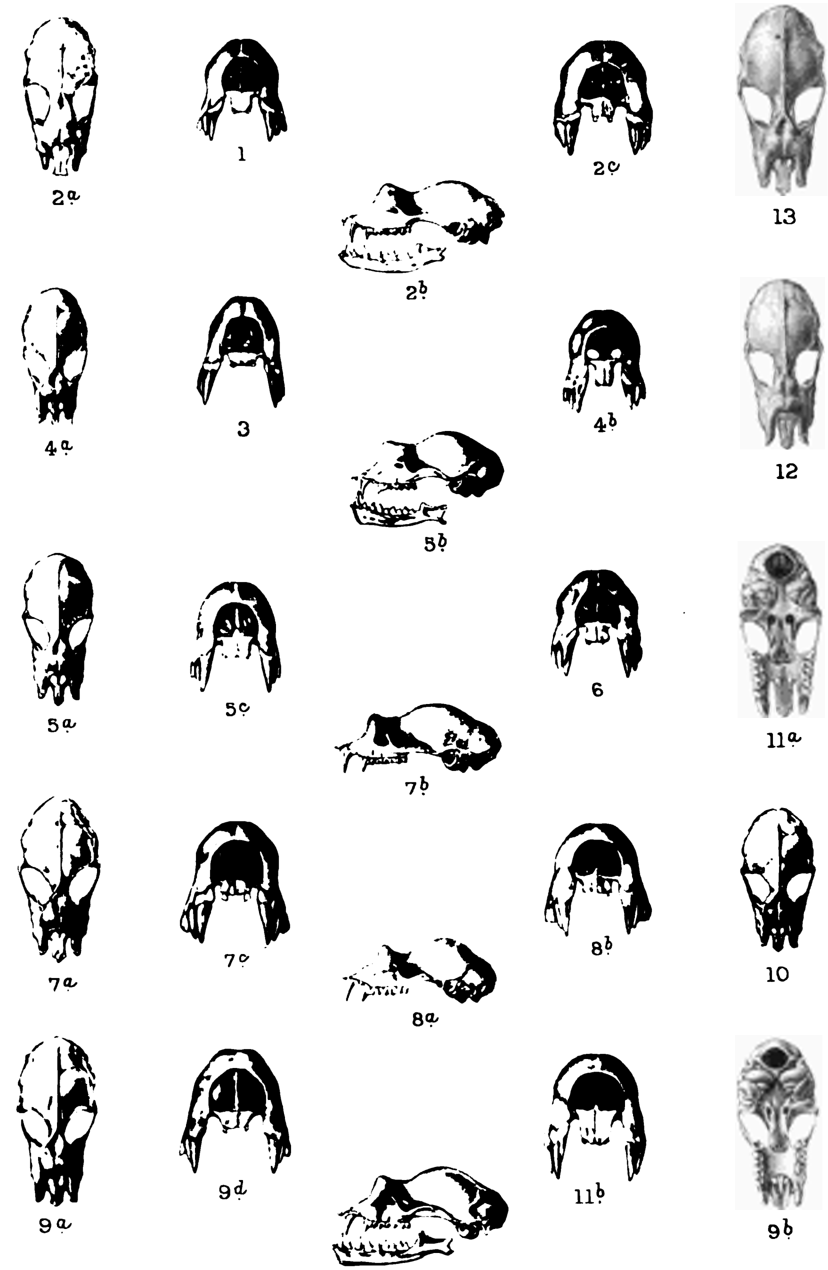
by 1521 had placed more or less roughly on the map all the big islands of the Malay Archipelago. They were followed a few years later by Spanish, Dutch, and French adventurers. During the 17th Century many British ships visited Sumatra and Borneo, and the Malay name Orang utan was in current use in scientific Europe during the second half of the 17th Century, having been originally definitely applied to the man-like apes of Sumatra and Borneo*.

But towards the close of the 15th Century the Portuguese had already become acquainted with the West Coast of Africa and the Chimpanzee. They first noticed this creature in the southern part of what is now the colony of Sierra Leone. They called it in their earlier writings "Selvage" (savage), and later "Barri." Later still they came to know more of the Chimpanzee in dealing with the Lower Congo and Northern Angola †. It there went under the name of Pongo, which as already explained is the Angola name Mpongo. Andrew Battel, of the 16th Century, was an Essex fisherman. Through being shipwrecked off Brazil he got conveyed into Portuguese captivity in Angola. Escaping, he travelled into the northern part of Angola towards the Congo. He returned to England and brought back with him stories of the "Pongos," which obviously referred to the Chimpanzee. The name "Chimpanzee" does not seem to have come into vogue till the latter part of the 18th Century, or to have been much used until the 19th Century. I have no certain clue as to its origin; but I have been told that it is a Loango word of which the root would be -mpanzi or -mpangi (possibly, therefore, cognate with the Congo name for Chimpanzee, mpongi), with the well-known Bantu prefix *chi* (*ki*) added. This prefix is sometimes an augmentative, so that chimpangi or chimpanzi might merely mean a big ape.

At the close of the 18th Century, Buffon, Linnæus, Lacépède, and other zoologists had finally discriminated between the Gibbons, the Orang utan, and the African Chimpanzee; and to this list was added in the period between 1847 and 1860 the definitely established genus (afterwards species, then again genus) of the Gorilla. The discovery of the Gorilla was really due to the American Evangelical missionaries, who established themselves in the early part of the 19th Century in the Gaboon; but complete specimens of this Ape and a far more extended knowledge of it were brought to the civilised world by Du Chaillu. Stanley asserted the existence of the true Gorilla as far east as the forest between the Upper Congo and the Nile watershed; and this statement has seemingly been confirmed by the specimens received from that region by Dr. Matschie, and described and figured by Mr. Rothschild.

* Though often misapplied to the African Chimpanzee in the 17th and 18th Centuries by English and Dutch sea-captains, who, having first made acquaintance with the Orang in the Malay Archipelago, saw Chimpanzees at the West African ports on their return voyage.

† When I visited Angola in 1882 Chimpanzees were still found in forested regions inland south of the Congo and north of the Quanza River, especially in the old kingdom of Congo.



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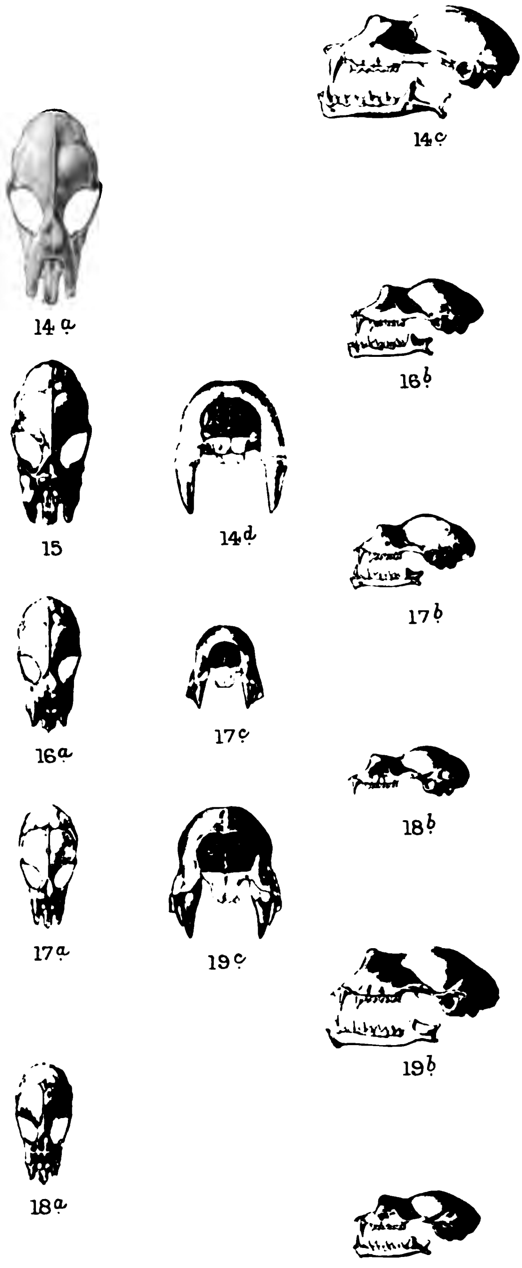
SKULLS OF RHINOLOPHI.



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SKULLS OF RHINOLOPHI.

3. On some Bats of the Genus *Rhinolophus*, with Remarks on their Mutual Affinities, and Descriptions of Twenty-six new Forms. By KNUD ANDERSEN *.

[Received May 12, 1905.]

(Plates III. & IV.† and Text-figure 22.)

The present paper is, chiefly, an attempt to disentangle some of the more complicated groups of Eastern *Rhinolophi*, to make out the probable interrelations of the species, and to describe the many new, imperfectly known, or hitherto confused forms. I have appended some general remarks on the affinities of the Ethiopian and Western Palæarctic species.

The material placed at my disposal has been more extensive than that of previous writers on these Bats, namely, Prof. Peters (1871) and Dr. Dobson (1878); and I have approached the subject from a different point of view, basing the diagnoses of the primary groups, and, where possible, of the species and subspecies too, not on external and dental characters alone, but also on important differences in the skulls. This may account, partly at least, for the essentially different conclusions on many points at which I have arrived. On the other hand, the following pages afford ample proof that my material has not been complete enough to enable me to venture an answer on all the difficult questions, taxonomic or phylogenetic, that occurred to me during my work. I shall feel satisfied if my paper is considered of some use as a basis for further investigations.

I owe my sincere thanks to Mr. Oldfield Thomas for entrusting me with a revision of these Bats, for giving me unlimited access to the recently acquired, still unregistered specimens in the British Museum, especially those of the large and important "Tomes Collection," and also for having favoured me with much valuable information during the progress of my work.

I also have to acknowledge the kind assistance of Mr. Gerrit S. Miller, Jr., who sent me for inspection almost all the Indo-Malayan *Rhinolophi* preserved in the United States National Museum, including many new and interesting forms, part of which will be dealt with below.

For the loan of specimens for comparison, or for information on examples preserved in Continental Museums, I am indebted to Geheimrath Prof. Dr. Ehlers, Göttingen; Prof. Matschie, Berlin; Prof. Dr. Kurt Lampert, Stuttgart; M. Ch. Mottaz, Geneva; M. A. Ménégaux, Paris; and Prof. A. Cabrera Latorre, Madrid.

I. THE *RHINOLOPHUS SIMPLEX* GROUP.

Diagnosis. Basioccipital, between cochleæ, not unusually narrowed. Posterior connecting process low and rounded off (text-fig. 22 *a*, on p. 121).

* Communicated by OLDFIELD THOMAS, F.Z.S.
† For explanation of the Plates, see p. 145.

I include in this group 40 different forms (22 species), corresponding to *Rh. megaphyllus*, *affinis*, *capensis*, *clivosus*, and *ferrum-equinum* in Dobson's 'Catalogue of the Chiroptera in the British Museum.' Only the Austro-Malayan, Oriental, and Palæarctic forms will be described below, and only the first species in some detail, the description of the other forms being, as a rule, confined to the points in which they differ from the fundamental type. The Ethiopian species will be briefly mentioned in the "General Remarks" on the group (p. 117).

1. Rhinolophus simplex, sp. n. (Plate III. fig. 1.)

Diagnosis. Cranial character: supraorbital crests meeting at a point behind the middle of the orbit. External: sella distinctly constricted at middle. Forearm 44·2 mm.

Details. Nose-leaves large, as compared with those of the other Austro-Malayan species (*Rh. truncatus, nanus*). A supplementary leaflet distinctly visible in front of, and on the anterior part of the sides of, the horseshoe; a character common to all the members of the present group, but becoming gradually less pronounced in the more highly developed species (*affinis*, *ferrum-equinum*, and their allies); it seems to point back to the much more primitive genus *Hipposiderus*. Horseshoe so broad as to completely cover the upper lip; a slight indication of a tooth-like projection on either side of the median notch. Sella decidedly broader at base than at summit, and distinctly constricted at middle; summit rounded; height of sella, from angle between vertical portion and nasal lobe, about 4·8 mm., width at base 2·3, at constriction 1·9, at summit 1·8 mm.; front of sella densely covered with exceedingly short white hairs (scarcely observable without a lens). Posterior connecting process low and broadly rounded off. Lancet long, almost cuneate; length, from posterior transverse bridge, about 4·7 mm. Three mental grooves, as in all forms of this group, except the highest-differentiated species (*ferrum-equinum* and its nearest relations).

Ears, compared with those of the closely allied Austro-Malayan species, rather large, almost reaching the tip of the muzzle when laid forwards. Upper part of outer margin somewhat concave; tip blunt; no constriction below the tip.

Wing-structure very primitive: 4th and 5th metacarpals subequal in length (the 5th, if anything, a little shorter), and both of them but very slightly longer than 3rd; III.^{2}* less than $1\frac{1}{2}$ the length of III.^{1}; IV.^{2} and, especially, V.^{2} very short, being only a trifle longer than IV.^{1} and V.^{1} This structure of the wing is characteristic of *all* the primitive members of this group (*simplex*, *megaphyllus*, *truncatus*, *nanus*, *celebensis*, *borneensis*, *malayanus*, *rouxi*, &c.); it is first in so highly-developed forms as *affinis* and its various modifications (*ferrum-equinum*, &c.) that we find an important progress: prolongation of III.^{2}; shortening of the 3rd

* For brevity's sake I call the proximal phalanges of the 3rd, 4th, and 5th fingers III.^{1}, IV.^{1}, and V.^{1}, the distal phalanges of the same fingers III.^{2}, IV.^{2}, and V.^{2}

metacarpal, as compared with the 4th and 5th; the 5th metacarpal decidedly longer than the 4th; &c.

Tail a little longer than the lower leg. Plagiopatagium inserted on tarsus.

Colour (of a spirit-specimen, unfaded). Fur of upper side a very dark shade of "drab," approaching "Prout's brown"; base of hairs rather more distinctly drab; under side somewhat darker than drab.

Skull. Four anterior nasal swellings and two posterior. The four anterior arranged in a transverse row, forming the upper and lateral borders of the nasal opening. Externally these anterior swellings are separated only by extremely faint linear depressions; internally by three bony lamellæ, also easily observable through the thin, transparent outer wall of the swellings. The posterior nasal swellings, situated immediately behind the anterior ones, at the front corner of the orbital cavity, are much lower, slightly concave at summit; three very faint lines divide them, rather indistinctly, into an upper, middle, and lower swelling.—The shape and arrangement of the nasal swellings, as here described, are, roughly speaking, the same in almost all the members of the *simplex*-group; there is some variation in the size of the swellings in the different species; but the more noteworthy deviations from the general scheme are two only: *Rh. malayanus* and *Rh. stheno.*

Postnasal depression triangular in shape, rather long; the supraorbital crests, which constitute the lateral border of this depression, meeting (and joining the sagittal crest) at a point more or less *behind* the middle of the orbital cavity. "Supraorbital length" of skull (*i. e.* distance between the point of junction of supraorbital crests and median anterior point of nasal swellings) greater than extreme width of nasal swellings.—The shape of this part of the skull, as here described, is characteristic of only the four most primitive members of the group (*simplex, megaphyllus, truncatus, nanus*).

Palatal bridge comparatively long (in antero-posterior direction); measured in the median line equal to about one-third the length of the upper tooth-row; median anterior point opposite the front of m^1, median posterior point opposite the middle of m^2.

Dentition. As a general guidance: in all existing species of the genus the upper p^3 * is completely lost; in all the more primitive

* I write the dental formula (excl. of incisors and canines) of a *Rhinolophus* with the most complete known dentition as follows: $\frac{p^2 \quad p^4\ m^1\ m^2\ m^3}{p_2\ p_3\ p_4\ m_1\ m_2\ m_3}$ (*cf.* Herluf Winge, "Jordfundne og nulevende Flagermus fra Lagoa Santa; med Udsigt over Flagermusenes indbyrdes Slægtskab"; E Museo Lundii, vol. ii. pt. 1 (1892), p. 56). As already mentioned by Winge, we have no *positive proof* whether the upper premolar lost in all known species is p^3 or p^2. For two reasons I regard the former alternative to be the more probable:—(1) In all *Rhinolophi*, also the most primitive forms, the lower p_3 is *on the point of being reduced*, in the more highly-developed species pushed definitely out to the external side of the tooth-row, in the still higher forms completely lost; it is but reasonable to suppose that the premolar *quite lost* in the upper jaw of *all* species corresponds to the premolar which is *on the point of being lost* in the lower jaw of *all* species, in consonance with the general rule that the teeth of the upper jaw show a *more advanced stage* of evolution than those

species of the *simplex*-group also the lower p_3 is very much reduced in size and *on the point of* being driven out of the tooth-row, to the external side; in all the more primitive species of the group also the upper p^2 is reduced in size, but still, *invariably*, in the tooth-row.

The following remarks apply to *Rh. simplex* and *Rh. megaphyllus*, the dentition of these two species, the most primitive within the present group, being practically exactly alike:—p_3 very small, but decidedly less reduced than in the other species of the group. The position of this tooth, in relation to p_2 and p_4, varies *individually* (in the same geographical race, and in examples from the same locality and of apparently the same age): completely in the tooth-row (one specimen), or slightly towards the external side (two), or half external (one), or almost quite external (one), or completely external (one). This "vacillation" in the position of p_3 is of some interest as being the first indication of a tendency towards driving this premolar out of the tooth-row, a tendency gradually increasing in a long series of more highly developed species, and culminating in the forms in which the tooth is quite lost, even in young individuals (*Rh. acrotis*).—p^2 is comparatively large, with a well-developed, pointed cusp. From its base to its tip this cusp is directed *obliquely inwards*, under an angle of about 25° to 45° with the vertical line; also in those species of the present group in which the cusp is so much reduced as to be scarcely perceptible without a lens, it is invariably pointing obliquely inwards, only to a still higher degree. The upper canine and p^4 always *widely* separated. In some individuals there is a very narrow interspace between p^2 and p^4, on either side of the jaw, or on one side, no doubt a remnant of the place where p^3, lost in all existing species, was situated (see footnote on p. 77).

Measurements *. On p. 80.

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of the lower jaw. (2) When the lower p_3 is external in position, or *even when it is completely lost*, we still, rather often, find p_2 and p_4 separated by a narrow interspace, reminiscent of the time when p_3 had its normal position in the tooth-row; if we can find, sometimes at least, a similar "atavism" in the upper jaw, our supposition will be strengthened; and such cases are, in fact, not very rare:—in some individuals, and just those of the most primitive species of the genus (*simplex*, *megaphyllus*, *borneensis*, *refulgens*, *philippinensis*), I find an arrangement of the upper teeth which can be graphically expressed as follows: cp $pm^1m^2m^3$, *i.e.* the anterior of the upper premolars in contact with the canine, the posterior in contact with the first molar, but *between the two "p" still a narrow interspace*, apparently a remnant of the place where the lost premolar was situated; if so, however, the lost p is, of course, p^3, those present p^2 and p^4.

* Only the following measurements require some explanation:—***Ears***, length from base of inner margin to tip. ***Forearm***, from posterior point of radius to front curve of carpus (wing bent), therefore somewhat greater than the length of radius measured on skeletons. ***Metacarpals***, as far as possible the true length of the bones. ***2nd phalanx***, always *exclusive of the* cartilaginous "*3rd phalanx*" (this restriction being of especial importance in measurements of the 3rd finger, the terminal cartilaginous rod of which is comparatively large). ***Hind foot***, with claws. ***Skull, total length***, to front of *canines* (not to front of premaxilla). ***Width of brain-case***, above root of zygomata. ***Supraorbital length***, distance between point of junction of supraorbital crests with sagittal crest and median anterior point of nasal swellings. ***Mandible***, condylus to front of incisors. ***Upper*** and ***lower teeth***, exclusive of incisors.

Type. ♀ ad. (in alcohol). Lombok, 2500 ft., June 1896. Collected by A. Everett, Esq. Brit. Mus. no. 97.4.18.4.

2. Rhinolophus megaphyllus Gray. (Plate III. fig. 2 *a*, *b*, *c*.)

Diagnosis. Allied to *Rh. simplex*, but considerably larger. Forearm 46–50 mm.

Details. This is a large continental representative of the *simplex*-type. The evidences of its close connection with the Lombok species are clear enough: the general shape of the facial portion of the skull; the wide interspace between the upper canine and p^4; the presence, individually at least, of an extremely narrow interspace between p^2 and p^4; the distinctly constricted sella; the strong development of the nose-leaves; the large ears. On the other hand, it has in several respects taken its own course of development: the sella is, also proportionately, broader than in *simplex*, the constriction at the middle is more abrupt; the nasal swellings are, also proportionately, considerably broader; the size of the animal is markedly increased: as regards this latter, *Rh. megaphyllus* bears quite the same relation to *Rh. simplex* as *Rh. rouxi* does to *Rh. borneensis*.

Distribution *. Eastern Australia. Louisiade Archipelago.

Geographical races. There are two apparently well-marked forms of *Rh. megaphyllus*, differing in size and in geographical habitat.

2 *a*. Rhinolophus megaphyllus Gray, typicus.

Rhinolophus megaphyllus J. E. Gray, P. Z. S. 1834, p. 52.

Rhinolophus megaphyllus (partim) Peters, MB. Akad. Berlin, 1871, p. 306 †; Dobson, Cat. Chir. Brit. Mus. (1878) p. 110.

Diagnosis. Larger: forearm 46·5–50 mm.

Sella. In one, out of eleven specimens, the summit of the sella is completely square-cut; in all the others (some of them from the same locality) it is broadly rounded off. Conf. with this *Rh. borneensis*.

Colour. (1) Dark phase (two skins, one adult and one full-grown, but young): Like *Rh. simplex*.

(2) Russet phase (one skin, full-grown individual, but young): Uniform "russet" above and below; base of hairs of upper side "clay."

Measurements. On p. 80.

Distribution. Eastern Australia: Queensland, New South Wales.

Technical name. The type of *Rh. megaphyllus* is in the British Museum.

* The information on the "distribution" of the species and subspecies reviewed in this paper is based *exclusively* on the material examined by myself.

† I am unacquainted with Peters's hypothetical *Rh. keyensis*, based on an example in the Leiden Museum, and characterised as "eine vielleicht nur etwas kleinere Varietät [of *megaphyllus*] oder Art" (*l. s. c.* p. 307). No further information has been published, and nine years later Peters records "*Rh. megaphyllus*" from the Key Islands without any reference to *Rh. keyensis* (Ann. Mus. Civ. Genova, xvi. (1880) p. 32). It is not very likely that the typical *Rh. megaphyllus* should occur in the Key Islands.

2 *b*. RHINOLOPHUS MEGAPHYLLUS MONACHUS, subsp. n.

Diagnosis. On an average smaller than the typical form: forearm 46 mm.

Details. Sella a trifle broader at base than in the typical form; summit completely square-cut; front face a little more distinctly haired. Length of forearm almost as in the smallest individuals of the typical form, but metacarpals distinctly shorter. Tail also comparatively somewhat shorter. Brain-case decidedly more slender. Tooth-rows somewhat shorter. In colour scarcely different from the dark phase of the typical form.

Measurements. Below.

Type. ♀ ad. (in alcohol). St. Aignan's Island (Misima), Louisiade Archipelago. Collected by Albert S. Meek, Esq. Brit. Mus. no. 98.4.1.1.

Measurements of Rh. simplex *and* megaphyllus.

	Rh. simplex.	*Rh. megaphyllus.*		
	♀ ad. Type.	f. *typica.* 11 specimens, 5 skulls.		*monachus.* ♀ ad. Type.
		Min.	Max.	
	mm.	mm.	mm.	mm.
Ears, length	18	18	19·5	19·8
„ greatest breadth	13·5	13·5	15	15
Nose-leaves, total length	14·5	15	16·2	14·8
„ breadth of horseshoe	8·5	8·8	9·8	8·8
Forearm	44·2	46·5	50	46
3rd metacarpal	31·8	33·8	36	32·7
III.[1]	13	13	14·6	13·2
III.[2]	17·8	17·5	20	17·8
4th metacarpal	32	34·3	36·8	33·5
IV.[1]	9·2	9·8	11·2	9·7
IV.[2]	11	11·5	13·3	10
5th metacarpal	31·8	34·3	36·5	32·7
V.[1]	10	10·4	12·7	10·2
V.[2]	11·2	11·7	14	11·7
Tail	24·5	22·2	26·8	20·5
Lower leg	19·7	18·5	22	19
Foot	8·8	9	10·2	8·7
Skull, total length	18·7	19·9	20·5	19·3
„ mastoid width	9	9·8	9·8	9·5
„ width of brain-case	7·8	8·5	8·6	8
„ zygomatic width	9·4	...	10	9·6
„ supraorbital length	6	6	6·8	5·9
„ width of nasal swellings	5·2	5·8	6	5·7
Mandible, length	12·8	13·3	14	13·2
Upper teeth	7·2	7·7	8·1	7·3
Lower teeth	7·8	8·2	8·7	8

3. RHINOLOPHUS TRUNCATUS Peters.

Rhinolophus truncatus Peters, MB. Akad. Berlin, 1871, p. 307.

Rhinolophus megaphyllus (non Gray), var. *a*, Dobson, Cat. Chir. Brit. Mus. (1878) p. 111.

Diagnosis. Allied to *Rh. simplex.* Sella more slightly constricted

at middle. Summit of sella square-cut, or even concave. Base of fur almost blackish. Forearm 44·7–46·8 mm.

Details. In this species the sella * is not of the shape characteristic of *Rh. simplex* and *megaphyllus*. It is narrower, not considerably broader at the base than at the summit, and the constriction at the middle is less distinct. This points decidedly away from *simplex*, and towards *nanus*, *celebensis*, and *borneensis*. The square-cut (or concave) summit of the sella seems to be a rather common feature in those forms of the present section of the group which are inhabitants of small islands (cf. *Rh. megaphyllus monachus*, *Rh. nanus*, *Rh. borneensis spadix*). Lancet long and cuneate. Wing-structure and proportionate length of tail as in *simplex*. Plagiopatagium inserted on tarsus.

Colour (six skins; adult individuals, but teeth quite, or almost, unworn). Very peculiar. General impression: a very dark brown. Details: hairs of upper side "broccoli-brown" at tip; below the tip, for a broad space, almost "clove-brown" (more exactly: an exceedingly dark shade of "hair-brown," very much approaching clove-brown); the extreme base of the hairs, immediately at the skin, again somewhat lighter. Individual hairs of the under side much of the same colour, but the tips more brightly broccoli-brown, giving the under side a somewhat lighter appearance. All the specimens are exactly alike in colour.

Skull. Essential characters as in *Rh. simplex*. Nasal swellings narrow.

Dentition. p_3 is, if anything, a little more reduced than in *simplex*. In two skulls I find it placed in the tooth-row, but slightly towards the external side; in a third, on the one side half external, on the other external; in a fourth, external on both sides, and the interspace between p_2 and p_4 therefore very narrow. p^2 is always in the tooth-row; its cusp rather well developed, though somewhat smaller than in *simplex*. No interspace between p^2 and p^4.

Measurements. On p. 84.

Distribution. Batchian.

Technical name. One of the two typical specimens (in the Berlin Museum) was collected on Batchian by A. R. Wallace and forwarded to Prof. Peters by Tomes. The whole series in the British Museum is from the same island and the same collector, and four of the examples belong to the recently acquired Tomes Collection; they are therefore practically (though not technically) co-types.

Remarks. The dentition of *Rh. truncatus* proves it to be on a slightly higher level than *simplex*; the interspace between the upper canine and p^4 is a little narrower, p^2 a little more reduced. The vacillation in the position of p_3 gives evidence of the same tendency as in *simplex*: towards the more advanced members of the group. In the shape of the nose-leaves it has taken a course pointing towards *borneensis*. In its coloration it seems to stand alone.

* A good series of skins, but no spirit-specimens, are at my disposal. This description is from the *resoftened* nose-leaves of three examples.

4. RHINOLOPHUS NANUS, sp. n. (Plate III. fig. 3.)

Rhinolophus megaphyllus (non Gray), var. β (partim), Dobson, Cat. Chir. Brit. Mus. (1878) p. 111 (Goram).

Diagnosis. Essential cranial characters as in *Rh. truncatus*, but brain-case remarkably slender. Sella so slightly constricted as to be practically parallel-margined. Small: forearm 43·3 mm.

Details. This species marks a further step towards the *celebensis-borneensis* type. Externally *Rh. nanus* is exceedingly like these two species, but the skull is of the *simplex* type.

The sella (compared with that of the foregoing three species) is considerably reduced in breadth; its width at the base is but very little greater than at the summit; the constriction at the middle is much reduced (it requires some attention not to be overlooked); and the whole of the sella therefore might very well be called almost parallel-margined; summit completely square-cut (there will probably, in a large series, be some individual variation in this respect). The horseshoe, too, is a little narrower. Lancet almost cuneate, the lateral margins being but very slightly concave. The size of the ears, both length and breadth, is reduced; the tip slightly more attenuated (less blunt than in *Rh. simplex*). In the structure of the wings it stands exactly on the same level as the foregoing species.

Colour (one skin; adult; teeth almost quite unworn).—Fur of the upper side uniform dull "mars-brown"; base of hairs slightly lighter; under side very much of the same colour as the upper side, but with a slight tinge of "drab."

Skull. Postnasal depression and supraorbital crests as in *Rh. simplex.* Nasal swellings very narrow (4·9 mm.). Chief character (compared with the three foregoing species): the very narrow brain-case (7 mm.).

Dentition. p_3 quite external, and cingula of p_2 and p_4 in contact (a sufficiently large series will presumably show some vacillation in the position of p_3). p^2 in the tooth-row; its cusp very small.

Measurements. On p. 84.

Type. Ad. (skin). Goram Island. Collected by Dr. A. R. Wallace. Brit. Mus. no. 61.12.11.10.

Remarks. This species is readily distinguished from *Rh. celebensis* and *Rh. borneensis* by the different shape of the facial portion of the skull.

Dobson regarded the specimen here described, together with two others from N. Celebes (Menado), as a variety ("β") of *Rh. megaphyllus*, characterised chiefly by having "the summit of the vertical process of the sella broadly rounded off, much broader than the base." But, firstly, it should be remembered that a sella, much broader at summit than at base, would be exactly the reverse of what is found in *megaphyllus*; it would even be unique in the whole genus. Secondly, on resoftening the nose-leaves I found the sella, in all the three specimens, quite of the same general shape as in *Rh. borneensis*, *i.e.* practically

parallel-margined. It would evidently have been much more to the point if Dobson had called these Bats *Rh. borneensis*, not *Rh. megaphyllus*. But *Rh. borneensis*, again, was confused with *Rh. minor*, which, however, not only is a distinct species, but belongs to a different group of the genus.

5. Rhinolophus celebensis, sp. n. (Plate III. fig. 4 *a*, *b*.)

Rhinolophus megaphyllus (non Gray), var. *β* (partim), Dobson, Cat. Chir. Brit. Mus. (1878) p. 111 (Menado).

Diagnosis. Supraorbital crests meeting at a point more or less in front of the middle of the orbit. Nasal swellings narrow. Nose-leaves as in *Rh. nanus* and *Rh. borneensis*. Small: forearm 43–44·7 mm.

Details. In the foregoing species (*Rh. simplex*, *megaphyllus*, *truncatus*, *nanus*), all of which are Australian or Austro-Malayan, the supraorbital crests join the sagittal crest at a point more or less *behind* the middle of the orbit. In *Rh. celebensis*, as in all the other species of the present group, which are all Oriental, Palæarctic, or Ethiopian, the supraorbital crests meet at a point more or less *in front* of the middle of the orbit. This makes a comparatively shorter postnasal depression, the supraorbital crests being the lateral borders of this depression. In this point therefore *Rh. celebensis* agrees with the *Western* forms of the group, differing from the Eastern.

The mechanical reason for this modification is evidently the following: a slight increase in the size of the temporal muscle has pushed the sagittal crest more forwards; this involves a shortening of the supraorbital crests; this again a reduction in the length of the postnasal depression.

The nasal swellings are narrow (4·8 mm.), as in the closely related Eastern forms (*nanus*, *truncatus*). In the more Western *Rh. borneensis* they are, at least somewhat, and as a rule considerably, broader. Compare figs. 4 and 5 on Pl. III.

It is worth noticing that the cranial characters of this species are, so to say, "in accordance with" its geographical habitat: Celebes is, geographically, intermediate between the Austro-Malayan and Indo-Malayan subregions, and in its more important cranial characters *Rh. celebensis* points partly westwards (shortening of supraorbital crests), partly eastwards (narrow nasal swellings).

The nose-leaves, ears, wings, and the general size are as in *Rh. nanus* and *Rh. borneensis*.

Colour. (1) Makassar specimen (♀ ad.; in alcohol; unfaded; teeth unworn).—General impression of upper side: brown; the true colour is a deep brown shade of "drab"; base of hairs a little lighter than drab; under side drab with a tinge of "broccoli-brown."

(2) Menado specimens (two skins; ad.; teeth almost unworn).—Above uniform dull "mars-brown," base of hairs but

slightly lighter; colour of the fur of the under side very much as on the upper side.

The Makassar specimen seems to represent the true "dark phase"; the mars-brown tinge of the Menado skins may indicate a tendency towards a "russet phase." Similar differences in colour are very common in this section of the group.

Dentition. As in *Rh. nanus.*

Measurements. Below.

Type. ♀ ad. (in alcohol). Makassar, S. Celebes, November 1895. Collected by A. Everett, Esq. Brit. Mus. no. 97.1.3.19.

Distribution. Celebes: Makassar, Menado.

Measurements of Rh. truncatus, nanus, *and* celebensis.

	Rh. truncatus.		*Rh. nanus.*	*Rh. celebensis.*	
	6 specimens, 4 skulls.		Ad. Type.	3 specimens, 3 skulls.	
	Min. mm.	Max. mm.	mm.	Min. mm.	Max. mm.
Ears, length	...	...	...	16	...
„ greatest breadth	...	...	...	12·5	...
Nose-leaves, total length	...	...	...	12·3	...
„ breadth of horseshoe	...	...	...	8	...
Forearm	44·7	46·8	43·3	43	44·7
3rd metacarpal	31·2	32·3	30	30·5	31·4
III.^{1}	13·2	14	11·2	12·2	13
III.^{2}	18·2	19·1	...	17·3	17·8
4th metacarpal	32	33·5	31·1	31·3	32
IV.^{1}	9·8	10·6	8·8	9	9·7
IV.^{2}	11·2	12·5	...	10·8	11
5th metacarpal	31·7	33·2	31·1	31	32·5
V.^{1}	10·7	11·7	9	9·5	10
V.^{2}	11·8	11·9	9·8	11	...
Tail	23	...	...	20	...
Lower leg	18·8	20	...	17·8	18·3
Foot	...	...	...	8·5	...
Skull, total length	...	...	...	18·1	...
„ mastoid width	9·2	...	...	9	...
„ width of brain-case	...	...	7	8	...
„ zygomatic width	...	...	...	9	...
„ supraorbital length	5·5	5·7	5·8	4·8	4·8
„ width of nasal swellings	5·1	5·1	4·9	4·8	4·8
Mandible, length	12·8	13·1	13	12·2	12·7
Upper teeth	7·1	7·3	7·2	7	7·2
Lower teeth	7·8	7·9	7·8	7·4	7·8

6. Rhinolophus borneensis Peters. (Plate III. fig. 5 *a, b, c.*)

Diagnosis. Similar to *Rh. celebensis*, but with broader nasal swellings. Small: forearm 41·2–46·3 mm.

Details. Sella so slightly constricted as to be almost parallel-margined from base to summit; in some individuals the constriction is completely obsolete; height of sella about 3 mm.;

width at base, at middle, and at summit: 2, 1·8, and 1·7 mm. Lancet almost cuneate, or the lateral margins but slightly concave, never abruptly narrowed at the middle (as in *Rh. rouxi*); length of lancet about 4·2 mm. Ears and wings quite as in *Rh. celebensis*. Plagiopatagium inserted on tarsus, or as much as 1·5 mm. above the tarsal joint.

Colour. There is an extreme dark phase and an extreme red phase, connected by several intermediate stages.

(1) Dark phase.—♀, Banguey Isl. (Brit. Mus.); two ♂, Pulo Sarutu (Un. St. Nat. Mus.); all of them *full-grown*, but with *unworn teeth*; distal epiphyses of metacarpals in two of them ossified, in one not completely so; in alcohol, unfaded. General impression of upper side: brown. The true colour is a deep brown shade of "drab"; base of hairs next to "broccoli-brown." Under side between "wood-brown" and "broccoli-brown." The individuals are not precisely, but almost, alike in tinge.

(2) Intermediate stage, nearer to "dark phase."—♂ ad., ♀ ad., Labuan (B.M.); ♂ ad., N.W. Borneo (B.M.); teeth either *quite unworn*, or *almost unworn*; distal epiphyses of metacarpals ossified; in alcohol, unfaded. Upper side "russet," base of hairs but slightly lighter. Under side "wood-brown."

(3) Intermediate stage, nearer to "red phase."—♀ ad., Sirhassen (U. N. S. M.); ♂ ad., ♀ ad., Karimata (U. N. S. M.); teeth either *quite unworn*, or very slightly worn; distal epiphyses of metacarpals ossified; in alcohol, unfaded. Much like the foregoing, but also the under side of the body "russet."

(4) Extreme red phase.—♂ ad., Sirhassen (B.M.); *teeth unworn*; epiphyses ossified; in alcohol, unfaded. Much like the extreme red phase of *Rh. rouxi*: not far from "cadmium orange" above; "orange" beneath.

As proved by the above, these differences in colour are independent of the geographical habitat and of the sex of the individuals, seemingly also of the age. So far as the present material goes, the only "phase" in which a quite young, though full-grown, individual occurs (epiphyses not quite ossified) is the dark phase; but it may be accidental: the individual which represents the extreme red phase is, at all events, only a few months older (teeth unworn).

Skull. As in *Rh. celebensis*, but with broader nasal swellings (5·4 mm., on an average).

Dentition. p_3 almost always completely external, but in one skull (out of eleven) half in row. Cingula of p_2 and p_4 in contact (six), or very slightly separated (four), or distinctly separated (one). p^2 always in the tooth-row; cusp very small. In four individuals there is an extremely narrow interspace between p^2 and p^4 (the former place of p^3).

Distribution. N. Borneo; S. Natunas; Karimata Group.

Technical name. The type of *Rh. borneensis*, in the Berlin Museum, is from Labuan. There are two specimens from the

same island in the British Museum *. As, however, *Rh. borneensis* has for many years been completely confused not only with several more or less closely related species, but also with the widely different *Rh. minor*, the following remarks may not be out of place here :—

The salient point in the original description of *Rh. borneensis*, as given by Prof. Peters (*loc. infra cit.*), is this: "Sattel . . . . an dem vordern obern Ende abgerundet, die hintere, zusammengedrückte Spitze [*i. e.* the posterior connecting process] *kaum höher, abgerundet*." I have emphasised the last three words, because they clearly prove that *Rh. borneensis* belongs to what here is called the *simplex* group (connecting process low and rounded off), and has nothing to do with *Rh. minor* or its allies (connecting process projecting and pointed). But ten years later (MB. Akad. Berlin, 1871, p. 306), Peters himself believed *Rh. borneensis* to be identical with *Rh. minor*, described by Horsfield so long ago as 1824. The reason was, beyond all doubt, this: to identify Horsfield's Bats without an examination of the types is, in most cases, impossible; and Peters had not seen the type of *Rh. minor* (then in the Indian Museum, London, now in the British Museum), but only the bad figure in the 'Researches in Java'; as, furthermore, the two species in many respects (size, wings, sella, ears, &c.) are, *externally*, puzzling alike, the mistake is easily explained. Thus, according to Peters, there were two small Indo-Malayan *Rhinolophi*: the one, with a low and rounded connecting process, he called *Rh. minor*, Horsf. (synonym: *Rh. borneensis*, Peters); the other, with a projecting and pointed connecting process, he identified with Temminck's *Rh. pusillus*, stated to be from Java. Under these circumstances, a quite reasonable conclusion: we had a name for either "species," and perfectly clear diagnoses.

Dobson, who examined the type of *Rh. minor*, states, quite correctly, that the connecting process is projecting and pointed; when, *nevertheless*, he put *Rh. borneensis* down in the list of "synonyms" to *Rh. minor*, he must have overlooked the most important point in Peters's description of *borneensis*, the shape of the connecting process. Dobson, therefore, called the small Indo-Malayan *Rhinolophus* with *pointed* process *Rh. minor* (synonym: *Rh. borneensis*): thus, the names were the same as employed by Peters, but the diagnosis exactly the reverse; Temminck's *Rh. pusillus* he identified with *Rh. hipposiderus* (sic); and as to the small Indo-Malayan *Rhinolophus* with *rounded* process (the true *borneensis*) he put it down under *Rh. affinis*, Horsf. (!), with which species he also united the very different *Rh. rouxi*, Temm., at the same time keeping a genuine *Rh. rouxi* separate as *Rh. petersi*. This accumulation of errors and wrong identifications

* On one point there is a discrepancy between Peters's description of *Rh. borneensis* and the series before me: according to Peters the length of the forearm is 37 mm.; in the smallest (adult) specimen I have seen, it measures 41·2 mm. I am informed by Prof. Matschie, who kindly re-examined the type for me, that Peters's statement must be a misprint or a slip of the pen; the forearm of the type specimen (a rather young, but apparently full-grown individual) measures 41 mm.

is the true reason of the exceedingly confused state in which this group of Bats has remained, making a safe determination of specimens procured almost impossible.

Geographical races. There seems to be two forms of *Rh. borneensis*, differing, slightly, in the size of the ears, and in geographical habitat.

6 *a*. RHINOLOPHUS BORNEENSIS Peters, TYPICUS.

Rhinolophus Borneensis Peters, MB. Akad. Berlin, June 25th, 1861, p. 709.

Rhinolophus minor (partim, nec Horsf.), Peters, MB. Akad. Berlin, 1871, p. 306; Dobson, Cat. Chir. Brit. Mus. (1878) p. 114.

Rhinolophus affinis (partim, nec Horsf.), Dobson. op. cit. (1878) p. 112.

Diagnosis. Ears slightly shorter: 16–17 mm., and narrower: 12·2–12·8 mm. Forearm 41·2–43·7 mm.

Details. In one specimen (from Banguey Isl.) the summit of the sella is completely square-cut; in the others (Labuan, N.W. Borneo) it is broadly rounded off. This is, no doubt, an individual variation, but, it would seem, of more frequent occurrence in individuals inhabiting smaller islands (cf. *Rh. megaphyllus monachus*, *Rh. nanus*, *Rh. truncatus*, *Rh. borneensis spadix*).

Measurements. On p. 88.

Distribution. N.W. Borneo; Labuan; Banguey.

6 *b*. RHINOLOPHUS BORNEENSIS SPADIX Miller.

Rhinolophus affinis rouxi (non Temm.) Thomas, Nov. Zool. i. (1894) p. 656.

Rhinolophus spadix Gerrit S. Miller, Jr., Proc. Wash. Ac. Sci. iii. (March 26th, 1901) p. 136.

Diagnosis. Ears slightly longer: 17–19·5 mm., and broader: 12·5–14·2 mm. Forearm 42·5–46·3 mm.

Details. In one specimen (Sirhassen Isl.) the summit of the sella is completely square-cut; in all the others (one of them from the same island) it is broadly rounded off.

Measurements. On p. 88.

Distribution. S. Natunas (Sirhassen); Karimata Group (Karimata and Pulo Sarutu).

Technical name. The type of "*Rh. spadix*," in the Washington Museum, is from Sirhassen. There is a specimen from the same island in the British Museum. I am indebted to Mr. Miller for the loan of a paratype, also from Sirhassen, and of the series from the Karimata Group, collected by Dr. Abbott.

Remarks. I should not have separated these two forms (if they be so) of *borneensis*, if the latter of them had not, accidentally *, got a name. There is no tangible difference in the skulls, not even

* When describing *Rh. spadix* as a new species, Mr. Miller compared it with *Rh. affinis*. He could not, very well, compare it with *Rh. borneensis*, which was regarded as identical with *Rh. minor*.

(as might perhaps be expected) in the measurements of them. It may well be that the few examples from N.W. Borneo, Labuan, and Banguey (four only) happen to be rather short-eared (and short-armed), and therefore do not show the true limits of individual variation in these respects. I prefer to keep them separate, provisionally at least, to call attention to the *possible* existence of two very slightly differing forms of the species.

7. Rhinolophus virgo, sp. n.

Diagnosis. Similar to *borneensis*, but much smaller. Forearm 37·5–38·8 mm.

Details. This is decidedly the smallest species of the present group. The horseshoe is markedly narrower than in any other form of the *borneensis* type; the sella considerably smaller than in *borneensis*, but of the same shape; the ears much shorter and narrower.

Colour. Probably not far from being the same as in the dark phase of *borneensis* (the two specimens examined are evidently somewhat faded in alcohol).

Measurements of Rh. borneensis *and* virgo.

	Rh. borneensis.				*Rh. virgo.*	
	f. *typica.* 4 specimens, 4 skulls.		*spadix.* 6 specimens, 7 skulls.		2 specimens, 2 skulls.	
	Min. mm.	Max. mm.	Min. mm.	Max. mm.	Min. mm.	Max. mm.
Ears, length	16	17·1	17·2	19·5	14·7	15·2
„ greatest breadth	12·2	12·8	12·5	14·2	10·7	10·8
Nose-leaves, total length	12·5	13·7	12·7	14·2	10·7	11·2
„ breadth of horseshoe	8	8·3	8	9	7·2	7·2
Forearm	41·2	43·7	42·5	46·3	37·5	38·8
3rd metacarpal	28·7	31·2	28·8	32·7	27·2	28·2
III.¹	12·1	13·5	11·7	14·2	10·2	10·7
III.²	16·2	18·7	16·6	19·9	15·2	15·2
4th metacarpal	29·7	32·2	30·7	34·5	28	28·6
IV.¹	8·8	9·7	8·2	9·8	7·3	8·2
IV.²	10	11·8	9·8	12	9	9
5th metacarpal	29·8	32·2	30·7	33·8	27	28·2
V.¹	9·5	10·3	9	10·3	8·1	8·8
V.²	10·2	11·8	9·8	12·2	8·2	8·3
Tail	18	19·2	18·3	21·5	17·9	20·2
Lower leg	17·8	19·2	17·2	19	14·2	15·2
Foot	8·8	9	8·5	9·1	7·2	8
Skull, total length	...	19·5	18·2	20	16·2	16·9
„ mastoid width	..	9·2	8·8	9·5	8	8·2
„ width of brain-case	...	8	7·8	8·2	7·1	7·7
„ zygomatic width	...	9·8	9	9·9	8·1	8·2
„ supraorbital length	5·1	5·2	5	5·2	4·7	5
„ width of nasal swellings	5·3	5·7	5·2	5·5	4·3	4·3
Mandible, length	12·2	13·1	12·2	13·7	10·8	11·5
Upper teeth	7	7·2	7	7·6	6·1	6·2
Lower teeth	7·5	7·8	7·4	8	6·5	6·8

Skull. As in *borneensis*, but considerably smaller; the nasal swellings are, also proportionately, narrower than in the Bornean species (perhaps as a consequence of the much smaller nose-leaves).

Dentition (two skulls). p_3 half in row (one skull), or external (the other). p_2 and p_4 in the former skull, of course, separated; in the latter almost in contact. p^2 in the tooth-row. Upper canine and p^4 widely separated.

Type. ♀ ad. (in alcohol). S. Camarinas, Luzon, Philippine Islands. Collected by L. M. McCormick, Esq. Un. St. Nat. Mus. no. 101966.

Remarks. This species is readily distinguished from any other form of the *simplex* group by its small size, narrow horseshoe, and short ears. The shape of the connecting process ought to prevent a confusion with the equally small species of the *minor* group, to which it, in other respects, bears a very striking *external* resemblance.

8. Rhinolophus malayanus Bonhote. (Plate III. fig. 6.)

Rhinolophus malayanus Bonhote, Fasc. Malayenses, Zool., i. (Oct. 1903) p. 15.

Diagnosis. Closely allied to *Rh. borneensis*, but median anterior nasal swellings somewhat more differentiated. Small: forearm 41·2–42·8 mm.

Details. Externally this Bat is exceedingly like *Rh. borneensis*, but the shape of the anterior nasal swellings is somewhat different. The colour, too, seems to be *constantly* different.

The sella is, in vertical direction, a trifle shorter, but the difference is scarcely appreciable without actual comparison with *borneensis*. The lateral margins of the sella are, practically, parallel from base to summit; an extremely faint constriction can be traced, at least under a lens; summit of sella rounded. Plagiopatagium inserted on tarsus, or very nearly so.

Colour. (1) Biserat specimens; two ♀ ad.; August and September; teeth slightly worn; in alcohol; unfaded.—Upper side a rather dark brown shade of "drab"; this colour is confined to the tips of the hairs; the much broader base of the hairs so light "ecru-drab" as to approach whitish; under side whitish "ecru-drab," somewhat darker on the sides of the body.

(2) Laos specimen; ad.; teeth slightly worn; skin.—Very much lighter. Upper side bright "cinnamon," base of fur "cream buff"; horseshoe patch * on back dark brown; under side buff.

* A dark-coloured patch on the upper side of the body, horseshoe-shaped, or like a V, the branches starting on each shoulder, convexity (or angle-point) directed backwards. It is curiously characteristic of many species of the families *Rhinolophidæ* and *Phyllostomatidæ*, but often (quite individually) more or less, or even completely, obliterated, especially, of course, when the fur also is dark-coloured. Being, as a rule, more common and more distinct in young or immature individuals, it is, probably, an inheritance from some remote ancestors of the two families. *Rhinolophidæ* and *Phyllostomatidæ* have, probably, had a common origin.

It looks like a dark and a light "phase." The dark phase differs from that of *Rh. borneensis*, chiefly, in having the under side of the body much lighter, in strong contrast to the colour of the upper side, and in having also the base of the hairs of the upper side much lighter. The light phase is, as will be seen from this description, totally different from the "cadmium orange" phase of *borneensis* (and more approaching the light phase of *Rh. affinis himalayanus*).

Skull. Essential characters as in *Rh. borneensis*, but the median anterior nasal swellings somewhat more distinctly marked off from the lateral anterior swellings.

Dentition. p_3 external; p_2 and p_4 almost in contact; p^2 in row, cusp extremely small.

Measurements. On p. 92.

Distribution. Biserat (Jalor, Malay Peninsula). Laos Mts. (Siam).

Technical name. The type is in the British Museum.

Remarks. From the Laos Mountains, Siam, I have seen one dried skin only (Tomes Collection); it looks like a light-coloured phase of *Rh. malayanus*; the nasal swellings of the (fragmentary) skull have the shape characteristic of this species. But fresh material from that region is desirable.

9. Rhinolophus nereis, sp. n. (Plate III. fig. 7 *a*, *b*, *c*.)

"*Rhinolophus rouxii*?" (non Temm.) Gerrit S. Miller, Jr., Proc. Wash. Ac. Sci. ii. (Aug. 20th, 1900) p. 234.

Diagnosis. Allied to *Rh. borneensis*, and of about the same size, but with much larger skull and teeth. Lower leg considerably longer: 21 mm. Tail comparatively very short: 17 mm. Forearm about 45 mm.

Details. In addition to the above:—The second phalanx of the third finger is more than 1½ the length of III.^{1}; this is the first time we have to note a decisive lengthening of III.^{2}; in *Rh. borneensis*, as in all the foregoing species, III.^{2} (always, in this paper, measured without the terminal cartilaginous rod) is invariably less than 1½ the length of III.^{1}; compare with this *Rh. stheno*, *thomasi*, *affinis*, *ferrum-equinum*. IV.^{1} is comparatively shorter than in *Rh. borneensis*, only about ¾ the length of the metacarpal of the same finger; compare with this *Rh. stheno*.

Colour. ♀ ad. (type); September; teeth almost quite unworn; first preserved in formalin, now in alcohol; probably unfaded.—"Mars-brown" above; base of hairs "ecru-drab"; of a peculiar yellowish "drab" beneath (? the yellow due to the influence of formalin).

Skull. Of the same general shape as in *Rh. borneensis*, but much larger, with considerably larger teeth, and therefore longer tooth-row; orbital constriction very narrow. The following measurements, in millimetres, will give a more precise idea of the differences (the ciphers in brackets are the measurements of eleven skulls of *Rh. borneensis*):—total length, inion to front

of canine 21·2 [18·2–20]; length of brain-case, inion to anterior point of proencephalon 13·7 [11·3–12·5]; width of brain-case above zygomata 9·5 [7·9–8·2]; zygomatic width 10·8 [9–9·9]; maxillar width, across antero-exterior corners of m^3 8·5 [6·8–7·2]; inter-orbital constriction 2·2 [2·4–2·8]; palatal bridge, median length 2·6 [1·8–2·3]; maxillar tooth-row 8·7 [7–7·6]; extreme width of m^1 2·2 [1·5–1·9].

Dentition. I have not seen the mandible of this Bat. p^2 in row; cusp almost imperceptible.

*Measurements**. On p. 92.

Type. ♀ ad. (in alcohol). Pulo Siantan, Anambas Group; September, 1899. Collected by Dr. W. L. Abbott. Un. St. Nat. Mus. no. 101714.

Remarks. As already pointed out above, the Bats of the *borneensis* type inhabiting the S. Natuna and Karimata groups, rather *close* to the north-western and western coasts of Borneo, are so extremely like the typical *borneensis* as to be, perhaps, scarcely separable. But *further westwards*, on the much more *isolated* Anambas Islands, the *borneensis* type has developed into the present, peculiarly modified species. In the lengthening of III.^{2}, the shortening of IV.^{1}, and the shortening of the tail (compared with the tibia), *Rh. nereis* has taken the same course as the still more western *Rh. stheno* (described below). But the shape of its skull sufficiently proves it to be an offshoot, not of that species, but of *Rh. borneensis*. Compare with this the "remarks" under *Rh. stheno.*

10. RHINOLOPHUS STHENO, sp. n. (Plate III. fig. 8, *a*, *b*.)

Diagnosis. Allied to *Rh. borneensis*, but anterior nasal swellings much more projecting. Lower leg long: 19·8–20·8 mm. Tail extremely short: 15·5–17·8 mm. Slightly larger than *borneensis*: forearm 45·2–48 mm.

Details. This is a third modification of the *borneensis* type, in several respects recalling *Rh. nereis*, in others quite peculiar. The shape of the facial portion of the skull is unique within the present group. As in *Rh. nereis*, III.^{2} is lengthened, IV.^{1} shortened; the tail is extremely short. The general size of the animal is slightly increased.

Plagiopatagium inserted 1–3 mm. above the ankle-joint.

Colour. ♂ ad., Penang; teeth unworn; skin.—General impression: reddish brown above; under side much lighter, contrasting with the upper side. "Mars-brown" above; base of hairs light "drab"; under side almost "broccoli-brown."—Three spirit-specimens (Selangor; teeth unworn) apparently agree in colour with the skin.

Skull (three individuals). Owing to the much more projecting anterior nasals wellings, the skull of *Rh. stheno*, in side view, is strikingly different from that of *Rh. borneensis*. This peculiarity

* The tip of the ears and the posterior nose-leaf are damaged; forearms broken.

in its outline is produced, not by a heightening of the anterior swellings, but by a reduction of the posterior pair; these latter, which in all the allied species form a sort of transition between the anterior swellings and the adjacent part of the supra-orbital crests and interorbital constriction, are in *stheno* so much reduced as to leave the anterior swellings more isolated, *i. e.*, more *abruptly* projecting.

Dentition. p_3 external; p_2 and p_4 in contact; p^2 in row, cusp extremely small.

Measurements. Below.

Type. ♂ ad. (in alcohol). Selangor, Malay Peninsula. Presented by H. N. Ridley, Esq. Brit. Mus. no. 98.3.13.1.

Distribution. Selangor; Penang.

Remarks. Rh. stheno differs from *Rh. borneensis* in the series of characters pointed out above. From *Rh. nereis*, in the shape of the facial portion of the skull, the much slenderer brain-case, and the shorter tooth-rows. From *Rh. rouxi*, in the shape of the facial portion of the skull; the much shorter metacarpals (although the forearm is of the same length as in smaller individuals of *rouxi*); the long III.[2] (compared with III.[1]); the short IV.[1]

Measurements of Rhinolophus malayanus, nereis, *and* stheno.

	Rh. malayanus.		*Rh. nereis.*	*Rh. stheno.*	
	3 specimens, 2 skulls.		♀ ad. Type.	4 specimens, 3 skulls.	
	Min. mm.	Max. mm.	mm.	Min. mm.	Max. mm.
Ears, length	16·2	16·8	...	17	17·5
„ greatest breadth	12	12·5	13·7	13	13·2
Nose-leaves, total length	13·2	13·2	...	13·8	14·2
„ breadth of horseshoe	7·8	8	9	8	8·3
Forearm	41·2	42·8	?45	45·2	48
3rd metacarpal	30	31	?33·2	31·5	32·7
III.[1]	11·1	12	13·2	12·6	13
III.[2]	15·3	16·8	21	20·1	21·7
4th metacarpal	30·2	31·5	33·7	33	33·8
IV.[1]	8·8	9·3	8·7	8·2	8·8
IV.[2]	10	10·5	12·8	11	12·5
5th metacarpal	30	31·5	34	33·5	34·2
V.[1]	9·7	9·8	10·8	9	10·4
V.[2]	9·7	10	10·2	10·5	11·5
Tail	19·2	20·5	17	15·5	17·8
Lower leg	16·8	17·8	21	19·8	20·8
Foot	7·8	...	9·3	8·5	9·2
Skull, total length	18·4	...	21·2	19·7	20·2
„ mastoid width	8·8	...	10·2	9·3	10
„ width of brain-case	8	...	9·5	8·5	8·7
„ zygomatic width	9·2	...	10·8	...	10·1
„ supraorbital length	5·1	5·2	5·6	5	5·1
„ width of nasal swellings	5·2	5·6	5·8	...	5·5
Mandible, length	12·1	12·7	...	13·2	...
Upper teeth	6·8	7	8·7	7·4	7·9
Lower teeth	7·3	7·5	...	8·1	8·4

(compared with the fourth metacarpal); the excessively short tail; and the smaller hind foot.

Phylogenetically, *Rh. stheno* is evidently more closely connected with *Rh. nereis* than with any other hitherto known Bat. To call the resemblance between these two species (in III.², IV.¹, the tail) "convergence," would be a phrase only, not an explanation. There can scarcely be any doubt that the type of *Rhinolophus* to which the now existing *Rh. borneensis* belongs, sent off a branch *westwards*; a part of this branch, isolated on the Anambas Islands, developed into *Rh. nereis*; another part, in the Malay Peninsula, into *Rh. stheno* (cf. the diagram on p. 120).

11. Rhinolophus rouxi Temm. (Plate III. fig. 9 *a*, *b*, *c*, *d*.)

Diagnosis. Allied to *Rh. borneensis*, but larger, and with considerably longer metacarpals. Third metacarpal 34–38 mm. Forearm 46–51·5 mm.

Details. This is a large, continental representative of the *borneensis* type, characterised chiefly by the much longer metacarpals and the shape of the lancet. In general size, the continental *Rh. rouxi* bears the same relation to the insular *Rh. borneensis* as the continental *Rh. megaphyllus* does to the insular *Rh. simplex*.

The sella is practically parallel-margined from base to summit; not rarely some faint indication of a constriction at the middle can be traced; summit broadly rounded off. In *simplex* and its closest allies the lancet is long and quite (or almost) cuneate; in *borneensis* there is some tendency towards a slight emargination of the lateral margins of the lancet; this tendency has been carried almost to an extreme in *rouxi*: the lancet is *hastate*, i. e., abruptly narrowed in the middle, the tip well developed and slender (not abnormally shortened, as in *thomasi*); but still, individually (though, as it seems, rather rarely), in *rouxi*, the lancet is less abruptly narrowed, as an atavism towards a passed stage. The ears are as in *borneensis*.

Wing-structure almost on the *simplex-borneensis* stage, *i. e.*, III.² almost always *less* than $1\frac{1}{2}$ the length of III.¹ The rare individual exception, that III.² is equal to (or a mere trifle more than) $1\frac{1}{2}$ the length of III.¹, is of some interest as foreshadowing the next important step to be taken in the series of evolution, viz., from *rouxi* to *affinis*, in which species III.² is *always considerably more* than $1\frac{1}{2}$ the length of III.¹

Plagiopatagium inserted on, or 1–4 mm. above, the tarsus, *i. e.*, there is evidently some tendency to draw the insertion of this membrane *away* from the ankle-joint, a little higher up on the tibia; compare with this *Rh. affinis*. The proportionate length of the tail is as in *borneensis*.

Skull. The skull of *Rh. rouxi* is *larger* than that of *borneensis*, but I fail to find any appreciable difference in the shape—a strong evidence of the very close relationship between the two species. The individual variation in the size of the skull, in

rouxi, is rather considerable (as is also the variation in the external dimensions of this Bat); but among 18 skulls of the typical form of *rouxi*, from localities so many and so distant *inter se* as to represent practically the whole area covered by this form, I do not find any so small as the *largest* among 11 skulls of *borneensis* (and *b. spadix*); in so far there is no difficulty in discriminating them. The tooth-rows, too, in *rouxi*, are longer. As to the small S. Chinese race of *rouxi* (described below), the skull has the same length as the *largest* of *borneensis*, but the brain-case is decidedly broader, the zygomatic and maxillar width greater.

Dentition (19 skulls). p_3, most often, quite external (12 skulls); not rarely half in row, or $\frac{3}{4}$ in row (6 skulls); in one *aged* individual (teeth much worn) p_3 is wanting, on both sides of the mandible, and the alveoli have disappeared. Cingula of p_2 and p_4, most often, in contact or separated by a very narrow, sometimes almost hairfine, interspace (13 skulls); in the remaining (6) individuals, distinctly separated, but the width of the interspace is not always quite the same on both sides of the mandible.

The upper canine and p^4 are, with rare exceptions, distinctly separated, p^2 completely in the tooth-row (17 skulls, out of 19), as in all the foregoing species. The size of p^2 and, therefore, the width of the interspace between c and p^4 vary, however, to a certain extent; but in *no* instance is the width of the interspace as broad as (p^2 as well developed as) in *simplex*: this is a thing of the past. As to the remaining two skulls (Ceylon, Nepal), the interspace is very narrow, *p^2 half external*. This is the first time we have to note instances of p^2 not being *completely* in the tooth-row.

As a general conclusion:—(1) In *Rh. rouxi* p_3 has arrived so far on its way towards disappearance as to be, generally, external; but still, not rarely, the individual variation *falls back* to a former stage: p_3 partly in the tooth-row; and in some aged individuals the dentition (p_3 disappeared) *points forwards* to subsequent stages in the series of evolution: *Rh. ferrum-equinum* (p_3 rather often lost) and *Rh. acrotis* (p_3 always lost). (2) As to p^2 in *rouxi*, it is generally in the row, rarely half external; this latter, again, points *forwards* towards subsequent stages: *thomasi*, *ferrum-equinum*, and *acrotis* (p^2 always external, or lost).

Distribution. From S. China through the Himalayas to the Indian Peninsula and Ceylon.

Technical name. As *Rh. rouxi* has for many years been completely confused with *Rh. affinis*, some remarks are necessary to prove that the name *rouxi* belongs to the species here under consideration. The type locality of *Rh. rouxi* is "Calcutta" *; the types (in the Leiden Museum) were collected by the French naturalist, M. Roux. There is in the Tomes Collection (British Museum) a skin also collected by Roux. The essential points

* Temminck, *loc. infra cit.*, p. 30 *c*; Jentink, 'Catalogue systématique des Mammifères,' Mus. d'hist. nat. Pays-Bas, xii. (1888) p. 161 (under *Rh. affinis*).

in the original description as given by Temminck are the following:—

(1) In "taille, forme du corps, des oreilles et des follicules accessoires du nez" very much like Java specimens of *Rh. affinis* Horsf. It may be said so; the difference in the shape of the sella is not easily ascertained in dried skins.

(2) "Des proportions moins grandes," as compared with *affinis*. As measurements Temminck gives:—Of *rouxi*: forearm "1 pouce 10 lignes" (49·5 mm.), expanse of wings "10 pouces." Of *affinis*: forearm "1 pouce 10 lignes," expanse "11 à 12 pouces." 49·5 mm. is one of the commonest measurements of the forearm in the series before me. It looks a little contradictory that Temminck, having stated that *rouxi* is smaller than *affinis* (which is quite correct), gives precisely the same measurement of their forearms, though, at the same time, a considerably larger "expanse" of the latter species. But just that is the salient point. As a matter of fact, the two species *can* have the forearm of exactly the same length (very large *rouxi*, and small *affinis*); but also in that case, *the expanse of* Rh. affinis *is always markedly larger than that of* Rh. rouxi, for the obvious reason that in the former species the second phalanx of the third (longest) finger is always *absolutely* longer than in the latter.

(3) A red, a dark, and an intermediate phase of *rouxi* were known to Temminck. I have the same phases before me. That similar phases occur in *Rh. borneensis* has no bearing on the present technical question; *borneensis* lives far away from "Calcutta." The "phases" of *Rh. affinis* are different.

(4) "Les molaires de la mâchoire supérieure sont en même nombre que dans l'*affinis*, celles de l'inférieure en compte cinq, ou une de moins, par le manque total de la petite dent dont l'*affinis* est pourvu, et qui forme la sixième molaire." Since Temminck emphasises the "manque total" of p_3, I suppose that he has not overlooked this small tooth, but has examined a (probably aged) individual in which it was wanting (*cf.* the specimen mentioned above). The word "sixième" is, of course, a lapsus for "cinquième" (Temminck counted the "molars" from behind forwards).

To sum up:—There can be no doubt that Temminck's *Rh. rouxi* is the Bat here under consideration, being a species (1) bearing much resemblance to *Rh. affinis*; (2) of almost the same size, but with a markedly smaller expanse of wings; (3) with a red, a dark, and an intermediate phase; and (4) inhabiting the Continent of India.

"*Rh. petersi*."—The original description of *Rh. petersi* is meagre and vague; the figures of the head and nose-leaves published four years later are badly drawn; the type specimen (in the Calcutta Museum) has no indication of locality. This may sufficiently account for the fact that no technical name in the genus has been the source of more confusion. I therefore think it of some use to give a brief sketch of its rather complicated history in literature:—

(*a*) As to the identification of "*Rh. petersi*," in the *original*

sense of the term*, there are only two alternatives: it is either *Rh. rouxi* or a species of the *Rh. acuminatus* section. I have not the slightest hesitation in referring the name as a synonym to the former species. As, however, Dobson himself later on applied the name to two Bats of the *acuminatus* section, it will only be necessary to give evidence, from his own description, that he was mistaken. The only important points in the description of "*Rh. petersi*" as given by Dobson in 1872 and 1876, *i. e.* at the time *when he had access to the type specimen*, are the following (the italics are mine)—(1) The nose-leaves are "as in *Rh. acuminatus*, except the upper border of the posterior connecting process, which is *much less acute*." This statement alone would be sufficient. In *acuminatus* the shape of the sella and lancet is very much as in *rouxi*, but the connecting process, both in *acuminatus* and in *all* its allies (*sumatranus*, *calypso*, *audax*), is *projecting* and *pointed*; there is, in this respect, no difference between the species of the *acuminatus* section, and there is also no appreciable individual variation. When, therefore, Dobson in this decisive point (the chief character of the whole group to which *acuminatus* belongs) declares his *Rh. petersi* to be very different from *acuminatus*, it may safely be said that it has nothing to do with that group. Dobson had evidently before him an example of *Rh. rouxi* with a *slightly raised* connecting process ("much less acute" than in *acuminatus*); such individuals are by no means rare; there are several in the British Museum, and the peculiarity is *purely* individual. Dobson found, quite naturally, that this peculiarity recalled that shape of the connecting process which had been described, one year earlier, by Peters in a species called by him *Rh. acuminatus* †, and, consequently, he compared it, in his paper, with this latter species, at the same time emphasising that there was a considerable difference. (2) The figure (side view) in Dobson's 'Monograph,' however bad it is, can scarcely represent the shape of the connecting process in *acuminatus*. Dobson has, no doubt, called the attention of his artist to the connecting process of the specimen to be figured as *Rh. petersi*, and the artist, in due obedience, has made his best to "emphasise" that point: this may account, I think, for the process being somewhat more exaggerated than in ordinary individuals of *rouxi*; but it is still not the process of an *acuminatus*. (3) The measurements of *petersi* are, without any exception, *perfectly* like those of several unquestionable specimens of *rouxi* measured by myself; there is not the slightest indication of a difference. (4) The type of *petersi* is from "India, precise locality unknown." The *acuminatus* section is distributed over Sumatra, Engano, Java, and Lombok. When Dobson wrote his 'Monograph,' there was not, in the Calcutta Museum, any specimen of any species of *Rhinolophus* from those islands; so that, if *Rh. petersi* were a member of the *acuminatus* section, the type, *without locality*, would have been

* Dobson, J. A. S. B. xli. pt. ii. (Dec. 22, 1872) p. 337; id., Monogr. Asiat. Chir. (1876) p. 49, text-figs. *a*, *b*.

† Peters, MB. Akad. Berlin, 1871, p. 304.

the only *Rhinolophus* in the museum from any of those islands. This is, of course, not beyond the limits of possibility; but it is certainly much more likely that *Rh. petersi*, as also the vast majority of the Bats in the Calcutta Museum at Dobson's time, came from some part of the Indian Peninsula or the Himalayas, the habitat of *Rh. rouxi*, and far from the home of *Rh. acuminatus* and its allies.

To describe a new species which subsequently proves to be an old one is no rare occurrence, and, as a rule, it does no very serious harm. But the strong emphasising of a purely individual peculiarity, combined with the circumstance that the type had no "locality," caused in this case a series of confusions: *Rh. petersi* emerged, like a ghost, very unexpectedly at such different places as the Gold Coast, Sumatra, the Himalayas, and S. India. And, curiously enough, the author of the "species" inaugurated the mistakes. When he had returned to London and was working out his 'Catalogue,' Dobson had no longer access to the type of *Rh. petersi*; he had his own short description only, and perhaps some private note. It is quite evident that, in these circumstances and occupied with the study of many other Bats, he lost the precise idea of the type specimen; he only kept in his memory, as its most important character, its "projecting" connecting process. So it came that he referred a specimen labelled "Gold Coast" to *Rh. petersi* *; for it is a genuine *acuminatus*, beyond all doubt from Java, and Dobson himself would scarcely have been able to tell why he called it *petersi* instead of *acuminatus*. Two years later, Dobson had for determination a collection of Bats belonging to the Göttingen Museum; among these he again believed he found a *Rh. petersi* †. I have had this example for inspection ‡; it is neither "*Rh. petersi*" nor *Rh. acuminatus*, but *Rh. sumatranus*.

(*b*) In a paper on some Himalayan Bats, Capt. Hutton § records *Rh. petersi* from Masuri. All the Bats mentioned by Hutton were presented to the "Indian Museum," and are now in the British Museum. The two specimens labelled "*Rh. petersi*" are *Rh. monticola*, a species closely allied to *Rh. lepidus* ||.

* Dobson, Cat. Chir. Brit. Mus. (1878) p. 114.

† Dobson, "On some new or rare Species of Chiroptera in the Collection of the Göttingen Museum," P. Z. S. 1880, p. 462.

‡ I am indebted to Geheimrat, Professor Dr. Ehlers, Göttingen, for the loan of this specimen.

§ Hutton, "On the Bats of the North-western Himalayas; with Notes and Corrections in Nomenclature by Prof. W. Peters," P. Z. S. 1872, p. 700.

|| As Hutton's article is one of the very few papers which give information respecting the *habits* of Himalayan Bats, and therefore has been frequently quoted by subsequent writers, I think it advisable to correct the following errors in the identifications of the four species of *Rhinolophus* dealt with in that paper:—"*Rh. affinis*" (p. 696) is *Rh. pearsoni*; "*Rh. rouxi*" (p. 697) is *Rh. affinis*; "*Rh. minor*" (p. 698) is *Rh. rouxi*; and, as pointed out above, "*Rh. petersi*" (p. 700) is *Rh. monticola*. Hutton's Bats were (as also stated in his paper) determined, not by himself, but by Prof. Peters in Berlin. But the mistakes are so strange that they cannot, certainly, be due to Prof. Peters; an extensive confusion of labels must have occurred (I can rather easily, from Peters's point of view, as laid down in his papers, guess the original arrangement of the labels), but the confusion had at all events taken place *before* the specimens were returned to Hutton.

(*c*) In Blanford's 'Fauna of British India' (*loc. infra cit.*) *Rh. petersi* is recorded from Masuri and from Nilghiri. The former statement is borrowed from Hutton's paper. The latter is based on an example collected by W. Davison in Coonoor, Nilghiri*. This specimen is now in the British Museum. It is a *Rh. rouxi*.

In short:—(1) For reasons given above I regard Dobson's *Rh. petersi* (1872 and 1876) as a synonym of *Rh. rouxi*; (2) Dobson's *Rh. petersi* (1878) is *Rh. acuminatus*; (3) Dobson's *Rh. petersi* (1880) is *Rh. sumatranus*; (4) Hutton's *Rh. petersi* is *Rh. monticola*; (5) Blanford's *Rh. petersi* is partly *Rh. monticola* (Masuri), partly *Rh. rouxi* (Nilghiri).

Geographical races. There are, at least, two forms of *Rh. rouxi*, differing in size and geographical habitat.

11 *a*. RHINOLOPHUS ROUXI SINICUS, subsp. n.

Diagnosis. Skull smaller, tooth-rows shorter. Forearm 46 mm.

Details. The general size is as in the very smallest examples I have seen of the typical form. Skull still a little smaller, with slenderer brain-case and shorter tooth-rows; nasal swellings, in front view, slightly lower. Colour as in the dark phase of Himalayan specimens of the typical form (see below).

Measurements. On p. 100.

Type. ♂ ad. (skin). Chin Tah, Anhwei, Lower Yangtse†. Presented by W. Styan, Esq. Brit. Mus. no. 99.3.1.6.

11 *b*. RHINOLOPHUS ROUXI Temm., TYPICUS.

Rhinolophus Rouxii Temminck, Mon. Mamm. ii. 8ᵉ monogr. (1835) p. 30 *b*.

Rhinolophus rubidus, cinerascens, rammanika Kelaart, Prodr. Faunæ Zeylanicæ (1852), pp. 13, 14.

Rhinolophus Rouxii (partim) Peters, MB. Akad. Berlin, 1871, p. 308.

Rhinolophus petersii Dobson, J. A. S. B. xli. pt. ii. (1872) p. 337 (nec Dobson, 1878, 1880); Blanford, Fauna Brit. India, Mamm. pt. ii. (1891) p. 275 (partim).

Rhinolophus minor (non Horsf.) Hutton, P. Z. S. 1872, p. 698.

Rhinolophus affinis (partim, nec Horsf.) Dobson, Cat. Chir. Brit. Mus. (1878) p. 113.

Diagnosis. Skull larger, tooth-rows longer. Forearm 46–51·5 mm.

Colour.—(1) *Specimens from Nepal and Darjeeling.* (*a*) *Dark phase*: one ad.; Nepal; teeth unworn; skin:—Upper side "mars-brown"; horse-shoe patch on back distinguishable, though somewhat obliterated; base of hairs light "drab," almost "ecru-drab"; under side "drab," with a tinge of "russet"; sides of body somewhat darker. With this skin agree in colour another adult specimen from Nepal (teeth somewhat worn; skin) and a ♀ ad. from Darjeeling (in alcohol).

* Blanford, J. A. S. B. lvii. pt. ii. no. 3 (1888) p. 261.

† For the exact position of this locality, see 'Ibis,' 1899, p. 289.

(*b*) *Light phase*: one ad.; Darjeeling; teeth slightly worn; skin:—Above inclining to "clay"; a strongly marked, deep brown horse-shoe patch; base of hairs and fur of under side almost "cream-buff."

(2) *Specimens from Ceylon and S. India.*—(*a*) *Dark phase*: three adult individuals; Ceylon; teeth rather slightly worn; skins:—Upper side a shade of brown, darker and duller than "mars-brown"; horse-shoe patch more or less effaced; base of hairs "drab," with a tinge of "ecru-drab"; under side "wood-brown" or light "drab."—This is Kelaart's *Rh. cinerascens.*

A skin (ad., January, teeth unworn) from Sirzi, Kanara, comes extremely near to the last-mentioned specimen, being only a little darker. A spirit-specimen from Nilghiri seems to be of very much the same colour.

(*b*) *Intermediate stage*: ♂ ad.; January; Sirzi, Kanara; teeth unworn. Upper side between "russet" and "mars-brown"; base of hairs "ecru-drab"; under side almost "clay."—This is Kelaart's *Rh. rammanika.*

(*c*) *Red phase*: one ad.; Ceylon; teeth worn; skin:—Above light "hazel" with a tinge of "orange-rufous"; horse-shoe patch almost obliterated; base of hairs and under side of body light "orange-rufous."—This is Kelaart's *Rh. rubidus.*

A skin (♂ ad., February, teeth unworn) from Jellapur, Kanara, represents the extreme of light colour: upper side next to "tawny-ochraceous"; base of hairs and fur of under side almost "orange-ochraceous."

Conclusions:—The dark phase in specimens from the Himalayas (Nepal, Darjeeling) is of a richer brown, more tinged with russet, than in specimens from Ceylon and S. India (Kanara, Nilghiri). The light phase, in specimens from the Himalayas, seems to be more inclining to "clay"; in specimens from Ceylon and S. India more "hazel" or "tawny-ochraceous." I do not think the series examined affords evidence conclusive enough to justify the separation of a Himalayan "race" and a southern (Ceylonese and S. Indian) "race." In all the other characters (external, cranial, dental; variation in general size) there is no appreciable difference. If they were to be separated subspecifically, the southern form would have to stand as "*Rh. rouxi rubidus* Kelaart," the Himalayan as "*Rh. rouxi typicus.*"

Measurements. On p. 100.

Distribution. Himalayas (Darjeeling, Nepal, Masuri). S. India (Nilghiri, Kanara) and Ceylon.

Remarks. Of the two forms here recognised, *Rh. rouxi sinicus* and *Rh. rouxi typicus*, the former, as coming nearest to *Rh. borneensis*, is no doubt the more primitive. The *rouxi*-type, therefore, has spread from an eastern point of the continent westwards, through the Himalayas, down the Indian Peninsula, to Ceylon.

12. Rhinolophus thomasi, sp. n. (Plate III. fig. 10.)

Rhinolophus affinis rouxi? (non Temm.), Thomas, Ann. Mus. Civ. Genova (2) x. (1892) p. 15, pl. xi. fig. 3.

Diagnosis. Allied to *Rh. rouxi*, but p^2 external to the tooth-row. Smaller than *rouxi*, with considerably shorter metacarpals, and the tip of the lancet excessively shortened. Third metacarpal 30·4–31 mm. Forearm 44·8–45·7 mm.

Details. While being similar to *Rh. rouxi* in the shape of the sella and the ears, and the proportionate length of the tail, *Rh. thomasi* differs, externally, from that species in the following particulars:—

The horse-shoe is considerably narrower; it is even narrower than in the smaller *borneensis* and in the much smaller *malayanus*. The tip of the lancet is exceedingly short, almost rudimentary; it is the hastate lancet of *rouxi* carried to an extreme.

The general size is smaller, as seen by the measurements of the forearm. But the metacarpals are proportionately *much* shorter, as short as in the much smaller *malayanus*. III.² is comparatively

Measurements of Rhinolophus rouxi *and* thomasi.

	Rh. rouxi.			*Rh. thomasi.*	
	sinicus. ♂ ad. Type.	*typicus.* 30 specimens, 18 skulls.		2 specimens, 1 skull.	
		Min.	Max.	Min.	Max.
	mm.	mm.	mm.	mm.	mm.
Ears, length	...	16·6	19	16·8	16·8
„ greatest breadth	...	13	15	12	12·2
Nose-leaves, total length	...	13·5	16·2	11·7	11·8
„ breadth of horse-shoe	...	8	9·2	7·2	7·5
Forearm	46	46	51·5	44·8	45·7
3rd metacarpal	34	34	38	30·4	31
III.¹	14·6	13·7	15·8	13	13·1
III.²	20·8	18·5	23·5	20·2	20·2
4th metacarpal	34·7	34·5	38·9	31·3	31·9
IV.¹	11·2	9·7	12	10	10·2
IV.²	12·3	11·7	14·5	12·2	12·7
5th metacarpal	35·4	35·4	38·9	32·3	32·7
V.¹	11·9	10·6	13·2	11	11·2
V.²	11·2	11·2	13·8	9	9·7
Tail	21	21	26·5	19	19
Lower leg	19·8	19	23·5	18	18
Foot	...	9	11·2	8	8·8
Skull, total length	19·8	20·3	23	18·2	...
„ mastoid width	9·5	9·7	10·8	9·2	...
„ width of brain-case	8·7	8·7	9·8	8·7	...
„ zygomatic width	10·3	10·4	11·8	10	...
„ supraorbital length	4·8	4·8	5·8	4·4	...
„ width of nasal swellings	5·8	5·5	5·9	5·3	...
Mandible, length	13·5	13	16·4	12·8	...
Upper teeth	7·7	8·2	9·2	7·1	...
Lower teeth	8·1	8·5	10·3	7·7	...

longer than in *rouxi*, *i. e.* more than 1½ the length of III.[1] (cf. *nereis* and *stheno*). V.[2] is extremely short.

Colour. To judge from specimens preserved in alcohol, probably not far from being the same as in the dark phase of Nepal examples of *Rh. rouxi*.

Skull. The *essential* characters are as in *rouxi*, thus proving *Rh. thomasi* to be an offshoot from that type of Bat, not (as might very well be supposed, in view of the short metacarpals) from *borneensis*. The skull of *Rh. thomasi* agrees with that of *rouxi* in the broad brain-case; it differs from *rouxi* in the much smaller size. Compared with *borneensis*, the skull of *Rh. thomasi* is as small as in the smallest individuals I have seen of *borneensis* (even as small as in *malayanus*), but the brain-case is markedly broader, even broader than in the largest *borneensis*, and the supraorbital length is exceedingly short (*cf.* measurements, p. 100).

Dentition. p_3 external; p_2 and p_4 in contact; p^2 *external. Upper canine and* p^4 *in contact.* Both of the specimens examined are identical in dentition.

Measurements. On p. 100.

Type. ♀ ad. (in alcohol). Karin Hills, Burma, 1888. Collected by Signor Leonardo Fea. Presented by Marquis G. Doria. Brit. Mus. no. 90.4.7.10.

I venture to connect with this fine species the name of Mr. Oldfield Thomas, who already thirteen years ago (*l. s. c.*) pointed out that it could scarcely be identified with any hitherto known form, but refrained from describing it as new, owing to the general confused state of this group of Bats.

13. Rhinolophus affinis Horsf. (Plate III. figs. 11–13.)

Diagnosis. Sella pandurate. p^2 in the tooth-row. Forearm 50–56 mm.

Details. This species marks an important progress in development as compared with *Rh. rouxi*. It is the base of the *ferrum-equinum* section.

The chief modifications are four: in the shape of the sella; in the structure of the wings; in the size of the animal; in the shortening of the palatal bridge.

In the *borneensis-rouxi* type the sella is practically parallel-margined; in *affinis* it is pandurate, *i. e.* the lateral margins concave, as in *ferrum-equinum*, though generally to a slightly less degree. In *simplex* and its closest relations the lancet is almost cuneate; in *borneensis* there is a tendency towards emargination of the lateral margins; in *rouxi* this tendency is carried to an extreme; in *affinis* the lancet falls back to the former stage: it is almost cuneate.

Throughout the whole series of forms reviewed above, with the exception of the somewhat aberrant *Rh. nereis*, *stheno*, and *thomasi*, the wings have remained at the same primitive stage: no lengthening of the second phalanx of the third finger. In *affinis* this phalanx has considerably increased in length, being always more

than, and with very rare exceptions *considerably* more than, $1\frac{1}{2}$ the length of the first phalanx, a peculiarity which is preserved in the subsequent stage of evolution: *ferrum-equinum.* The aberrant species just alluded to, viz. *Rh. nereis*, *stheno*, and *thomasi*, are, from this point of view, of especial interest, as being Bats of the *rouxi* type which already show the wing-structure characteristic of the more highly developed *affinis*.

Rh. affinis is larger than *rouxi*; but small *affinis* have the same length of the forearm as very large *rouxi*. In such cases, *Rh. affinis*, provided the specimens examined are fresh or preserved in spirit, can, of course, easily be discriminated by the shape of the sella and the length of III.^2; if preserved as dried skins (in which the shape of the sella is often difficult to recognise), still the latter character remains unchanged.

Colour. The many forms in which this species is differentiated seem to agree, rather closely, in colour:—

(1) Darker individuals: ♂ ad., Darjeeling (*Rh. a. himalayanus*); Oct. 22nd; teeth unworn; skin:—Upper side "mars-brown" with a rather strong hue of "drab"; no horse-shoe patch; base of hairs "ecru-drab"; under side "broccoli-brown."

Still darker is a ♂ ad. from Lombok (*Rh. a. princeps*); teeth somewhat worn; in alcohol; unfaded:—"Prout's brown" above, base of hairs "wood-brown"; under side almost "tawny-olive."

(2) Light-coloured individuals: ♂ ad., Nanking (*Rh. a. himalayanus*); July 5th; teeth somewhat worn; skin:—Extremely light. Above light "clay," almost "ochraceous-buff," hinder back somewhat darker; a rather distinct, "mars-brown" horse-shoe patch; base of hairs "cream-buff"; under side very light, almost "cream-buff."—A spirit specimen (♂ ad.) from the same locality (June 15th) is quite of the same colour.

Skull. The *essential* characters as in *rouxi*, proving that *Rh. affinis* originated from a Bat of that type. The skull is generally larger, and the gap in front between the maxillary bones wider. Chief character: the exceedingly short palatal bridge, as a rule only $\frac{1}{4}$ the length of the maxillar tooth-row, or *even less*; in *rouxi*, with very rare exceptions, decidedly more than $\frac{1}{4}$, sometimes almost $\frac{1}{3}$. The teeth, too, are slightly larger.

Dentition. p_3 external and extremely small; but, as a rare exception, this premolar may still, in this comparatively highly-developed species, show some tendency towards the tooth-row (one skull, out of 19), or be halfway in row (one). p_2 and p_4 generally quite, or almost, in contact (14 skulls); in the remaining somewhat more distinctly separated. p^2 always in the tooth-row, extremely small, and the interspace between the canine and p^4 rather narrow. In no less than five skulls there is an exceedingly narrow, in most cases almost hair-fine, interspace between p^2 and p^4 (the former place of p^3).

Distribution. From the N.W. Himalayas to S. China; through Indo-China, the Malay Peninsula, and N. Natunas, to Sumatra, Java, and Lombok.

Technical name. The type of *Rh. affinis* is in the British Museum. From the original description it would have been quite impossible to identify the species.

Remarks. Of all the races of *Rh. affinis*, the Himalayan form (*Rh. a. himalayanus*) is the most ordinary-looking: in the horse-shoe, the ears, the nasal swellings, the brain-case. There can hardly be any doubt that *the affinis type originated in the Himalayas*, and from there spread eastwards to S. China, south-eastwards through Indo-China, as far as Lombok.

Geographical races. There are, at least, seven forms of *Rh. affinis*, differing in certain cranial characters, in the size of the ears and horse-shoe, in the length of the tail and tibia, in general size, and in geographical habitat. Some of these forms may be called distinct species by other authors.

13 *a*. RHINOLOPHUS AFFINIS HIMALAYANUS, subsp. n. (Plate III. fig. 11 *a*, *b*.)

Rhinolophus affinis (partim) Dobson, Cat. Chir. Brit. Mus. (1878) p. 112.

Diagnosis *. External characters:—Size largest; ears small; horse-shoe narrow; tail short; lower leg short. Cranial: length of skull, width of brain-case, length of tooth-rows, moderate; nasal swellings narrow.

Type. ♀ ad. (in alcohol). Masuri. Collected and presented by Capt. Hutton. Brit. Mus. no. 79.11.21.148.

Distribution. Himalayas (Masuri, Nepal, Darjeeling); S. China (Nanking).

13 *b*. RHINOLOPHUS AFFINIS TENER, subsp. n. (Plate III. fig. 12.)

Diagnosis. External characters: Size small; ears small; horse-shoe broader; tail short; lower leg rather long. Cranial: skull short; nasal swellings and brain-case narrow; tooth-rows short.

Type. ♂ ad. (in alcohol). Pegu. Collected and presented by W. Theobald, Esq. Brit. Mus. no. 87.3.4.11.

13 *c*. RHINOLOPHUS AFFINIS MACRURUS, subsp. n.

Rhinolophus affinis Thomas, Ann. Mus. Civ. Genova (2) x. (1892) p. 922.

Diagnosis. External characters: Size moderate; ears larger; horse-shoe broader; tail long; lower leg longer. Cranial: length of skull, width of brain-case, length of tooth-rows, moderate; width of nasal swellings moderate.

Type. ♂ ad. (in alcohol). Taho, Karennee, Burma; Febr. 1888. Collected by Signor Leonardo Fea. Presented by Marquis G. Doria. Brit. Mus. no. 90.4.4.7.

* As the characters of the different forms of *Rh. affinis* are sufficiently clearly expressed in the table of measurements, p. 105, they will not be reviewed *in detail*, but only rendered in *general terms*, in the "diagnoses" of the subspecies.

13 *d*. Rhinolophus affinis superans, subsp. n.

Rhinolophus affinis (partim) Peters, MB. Akad. Berlin, 1871, p. 306; Dobson, l. s. c.

Diagnosis. External characters: As *macrurus*, but with short tail. Cranial: skull rather long; nasal swellings still broader than in *macrurus*; brain-case broad; tooth-rows rather long.

Type. ♀ ad. (in alcohol). Pahang, Malay Peninsula. Presented by the Selangor Museum. Brit. Mus. no. 0.7.3.2.

Distribution. Lower Siam (Trong); Malay Peninsula (Pahang); Sumatra.

Remarks. A specimen from Sumatra is in every respect, cranial, dental, and external, indistinguishable from those from Pahang and Trong (the latter sent for identification by the United States National Museum).

13 *e*. Rhinolophus affinis nesites, subsp. n.

Rhinolophus affinis Gerrit S. Miller, Jr., Proc. Wash. Ac. Sci. iii. (1901) p. 135.

Diagnosis. External characters: As *superans*, but smaller, and with shorter tibia. Cranial characters unknown.

Type. ♀ ad. (in alcohol). Bunguran Isl., N. Natunas, Aug. 24th, 1900. Collected by Dr. W. L. Abbott. Un. St. Nat. Mus. no. 104753.

Remarks. This is evidently an offshoot of the Malacca form, *Rh. a. superans*, isolated on the outlying N. Natunas, and developed into a well-marked race (or species). It still shows some of the chief characters of *superans*: the large ears, broad horse-shoe, and short tail; but, to judge from the metacarpals (the forearms are broken), it is decidedly smaller, it would seem still a little smaller than *Rh. a. tener*, and the tibia is very short. The skull is so much damaged that I have only been able to examine the teeth and the lower jaw.

13 *f*. Rhinolophus affinis Horsf., typicus.

Rhinolophus affinis Horsf., Zool. Res. Java (1824), pl. [7], figs. A, B.

Rhinolophus affinis (partim) Peters, l. s. c. (1871); Dobson, l. s. c. (1878).

I am unable to give a definite diagnosis of this, the "typical," form of *Rh. affinis*, having seen only one very old skin (the type) and a fragment of the skull, representing the facial portion and the tooth-rows. But these are sufficient to show, first of all, of course, the specific characters (pandurate sella, lengthened III.[3], dentition, &c.); secondly, that this form is quite different from any of its next neighbours, on Sumatra and the Malay Peninsula (*superans*), on the N. Natunas (*nesites*), or on Lombok (*princeps*). The horse-shoe seems, allowing for some shrinkage, to be quite as narrow as in *Rh. a. himalayanus*; the nasal swellings, too, are as narrow as in *himalayanus* and *tener*. But, although the

Measurements of Rhinolophus affinis *and subspecies.*

	himalayanus. 6 specimens, 7 skulls.		*tener.* ♀ ad. Type.	*macrurus.* 3 specimens, 3 skulls.		*superans.* 5 specimens, 5 skulls.		*nesites.* ♀ ad. Type.	*typicus.* Ad. Type.	*princeps.* ♂ ad. Type.
	Min.	Max.		Min.	Max.	Min.	Max.			
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Ears, length	17·2	18·5	18·8	20	20·7	20·2	20·5	20·2	...	21·3
„ greatest breadth	13·8	14·5	14·3	15·2	15·8	14·8	15·7	14·2	...	16·9
Nose-leaves, total length	13·9	14	13·8	14·8	16·5	14·8	17	...	...	18·2
„ breadth of horse-shoe	8	8·8	9·5	9	9·8	9·8	10	9·8	?8·1	11·1
Forearm	52	56	50	51	53·8	51·2	53	...	51	52
3rd metacarpal	37·7	40	35·8	37·7	39	36	38·2	35·2	37·5	37·6
III.[1]	15	16	14·3	14·8	16	14·6	15·2	14·3	15·2	15·5
III.[2]	26	30	25	24·8	26·5	23·8	26	24	24·8	24
4th metacarpal	38·8	41·2	37·1	38	40·7	36·8	38·8	36	37·5	39·5
IV.[1]	10·4	11·2	10	10·3	12·2	10	10·9	10·2	10	10·5
IV.[2]	16	18	14·3	14·5	16·5	14	15·3	14·8	13·8	14·9
5th metacarpal	39·2	42·4	38	39·2	41·2	37·7	39·5	36·8	38	39·8
V.[1]	12·3	13·8	11·8	12	13	11·2	11·9	11·5	12	11
V.[2]	12·1	14·1	13·3	13·5	14·8	12·2	13·5	12·2	...	13·1
Tail	21·8	25	23	26	29·3	21·5	25·2	22	...	21
Lower leg	22·8	23·8	24	23·9	25·4	25	25·8	22·8	24	26
Foot	11	12·8	12	11	12	11·1	12	10·2	...	12·4
Skull, total length	22·7	23·9	21·9	22·5	23·2	22·8	23·8	...	...	24·1
„ mastoid width	10·2	10·9	...	10·5	11	10·9	11·2	...	...	11·2
„ width of brain-case	9·2	10	9	9·3	9·8	9·8	10·2	...	...	10·5
„ zygomatic width	11·1	11·8	10·8	11·2	11·6	11·3	12·1	...	...	12·1
„ supraorbital length	5·2	5·5	5·2	5·2	5·9	5·7	6·2	...	5·2	5·9
„ width of nasal swellings	5·6	6	5·7	5·8	6·2	6·2	6·7	...	5·8	6·8
Mandible, length	15·8	16·5	15·5	15·7	16·7	15·8	16·3	15·3	...	17·2
Upper teeth	9	9·4	8·7	8·8	9·2	9	9·7	9	9	9·9
Lower teeth	9·7	10·2	9·2	9·6	9·9	9·7	10·1	9·7	9·7	10·5

specimen is slightly smaller than the smallest example of *himalayanus* I have seen, the tibia is fully as long as (if anything, a trifle longer) than in the very largest of these latter. On the whole, I have but very little doubt that *Rh. a. typicus* will prove to be much more closely related to the Burmese and Himalayan forms than to any of the others. This would be an additional evidence of the *closer* connection between the fauna of Java and that of Indo-China and the Himalayas—closer than between Java and the geographically nearer Sumatra, Malacca, and Borneo.

Distribution. Java.

13 *g*. RHINOLOPHUS AFFINIS PRINCEPS, subsp. n. (Plate III. fig. 13.)

Diagnosis. External characters: General size moderate; tail short; but largest in the size of the horse-shoe and ears, and the length of the tibia. Skull, nasal swellings, tooth-rows: the extreme.

Type. ♂ ad. (in alcohol). Lombok, July 1896. Collected by A. Everett, Esq. Brit. Mus. no. 97.4.18.13.

Remarks. Placed side by side with *Rh. a. himalayanus*, this form is strikingly different; the horse-shoe is no less than $\frac{1}{4}$ broader than the *broadest* in *himalayanus*, and the skull is distinguishable at a glance by its excessive width and the very broad nasal swellings. But it must be remembered that *superans* leads, not up to, but decidedly *in the direction* of, *princeps*, and we do not yet know the extreme limits of individual variation, either in *superans* or in *princeps*.

When considering the geographical races* of *Rh. affinis* from a more general point of view—and excluding "*typicus*," owing to the peculiar geological history of Java, as well as *nesites*, owing to its having, probably, been influenced by somewhat exceptional conditions, far away on the small isolated N. Natunas,—the following rule will be observed: the more southern or south-eastern the habitat, the longer the ears, the broader the horse-shoe, the longer the tibia, the larger the skull, the broader the nasal swellings, and the longer the tooth-rows.

14. RHINOLOPHUS FERRUM-EQUINUM Schreb. (Plate IV. figs. 14, 15.)

Diagnosis. Sella pandurate. p^2 completely external or wanting. Ears more than 20 mm. Width of horse-shoe less than 10 mm. Forearm 52·8–63 mm.†

Details. The *ferrum-equinum* type originated from a Bat in all

* I am unacquainted with Dobson's *Rh. andamanensis* (J. A. S. B. xli. pt. ii. (1872) p. 337). The only specimen known is in the Calcutta Museum. It seems to be a local representative of the *affinis* type.

† The first and second characters, combined, are sufficient to distinguish *ferrum-equinum* from all Oriental species of this group. The others are added to prevent confusion with those Ethiopian species of the present group which also have the sella pandurate and p^2 external or wanting (*clivosus, darlingi, acrotis*; *augur* and *deckeni*).

essential points similar to *Rh. affinis*. It agrees with the now existing *affinis* in the pandurate sella and the prolongation of III.[2]. But it is *considerably* higher-developed, chiefly in the following respects: (1) the dentition; (2) the wing-structure; (3) the length of the tail; (4) the beginning, or complete, reduction of the lateral mental grooves; (5) the general size.

The peculiar prolongation of the second phalanx of the third finger, described above under *Rh. affinis*, is preserved in *Rh. ferrum-equinum*: III.[2] is more than (or, extremely rarely, at least equal to) $1\frac{1}{2}$ the length of III.[1]. *Also* IV.[2] *is lengthened, i.e.* more than $1\frac{1}{2}$ of IV.[1]; it is an interesting fact that, in this particular point, *Rh. ferrum-equinum* (all races) agrees with *Rh. affinis himalayanus*, *but not with any of the other races of affinis*. Besides these two characters, which are simply inherited from an *affinis*-like ancestor, there is an important modification in another part of the wing, to which we have no parallel in any of the foregoing forms *, viz. *a change in the proportionate length of the third, fourth, and fifth metacarpals*, as shown in the subjoined table:—

	Forearm.	3rd metacarpal.	4th metacarpal.	5th metacarpal.
All the foregoing species (94 examples)	1000	715	739	740
Rh. ferrum-equinum (all races; 121 examples)	1000	644	724	743

This table shows:—(1) In all the foregoing 21 forms of this group the fourth metacarpal is but very little longer than the third (24 mm., for a supposed length of forearm of 1000 mm.), and the fifth metacarpal is practically of the same length as the fourth †. (2) In *ferrum-equinum a considerable shortening of the third metacarpal has taken place*; at the same time a much smaller reduction of the fourth metacarpal has occurred, so as to make the fifth metacarpal, slightly but *decidedly*, the longest of all.

The tail is proportionately *longer* than in the foregoing species, being, on an average, in the eastern races of *ferrum-equinum* (*nippon, tragatus, regulus*) exactly $1\frac{1}{3}$, in the typical form $1\frac{1}{2}$, the length of the lower leg, whereas *proximus*, in this point (as well as geographically), is intermediate between the eastern and western races ‡.

In all the foregoing forms, without exception, there are three

* But there is an exact parallel in an Ethiopian species, of the *affinis* type, viz. *Rh. darlingi* (see the "General Remarks," below, p. 118).

† It would only have made the table more complicated if I had given separate ciphers for all the foregoing species. The only difference (and an exceedingly small one) is that in *simplex, megaphyllus, truncatus, nanus, celebensis, borneensis, virgo,* and *malayanus* the fourth metacarpal is, almost always, a mere trifle *longer* than the fifth: in *nereis, stheno, rouxi, thomasi,* and *affinis* a mere trifle *shorter* than the fifth. However small this difference is, it is evidently the first faint trace of the modification definitely carried out in *ferrum-equinum*: the fourth metacarpal *always* shorter than the fifth.

‡ It is hardly necessary to say that a short tail cannot be a primitive character in the order Chiroptera, taken as a whole. But, for some reason or other, we find in the most primitive species of the genus *Rhinolophus* a very short tail; in the higher forms of the *present* group we see, again, a lengthening of the tail.

vertical grooves on the front of the lower lip. In the eastern races of *ferrum-equinum* (*nippon*, *tragatus*, *regulus*) sometimes exactly the same, but *very often* the lateral grooves are *more or less* reduced; in the western races (*proximus*, *typicus*, *obscurus*) they have, as a rule, almost or quite disappeared *.

As to the general size, the eastern races are, as it seems, always larger than any form of *affinis*; *proximus* and *typicus* at least on an average so; while *obscurus* is nearly of the same size as *affinis himalayanus*.

The remaining external characters need only a brief record:—

The supplementary leaflet is *slightly* more reduced than in *affinis*, and more closely united to the upper lip; this latter it is (more than the reduction) which makes it less distinctly visible. The posterior connecting process is more lengthened in antero-posterior direction, also a little more projecting, but quite rounded off at the summit. But, curiously enough, in one specimen (from Transcaspia) I find the process quite as in *affinis* (in all other specimens from W. Asia it is normal). The lancet has a marked tendency towards assuming a hastate shape, rather than a cuneate, the extreme tip being, generally, long and slender; but sometimes, and both in the eastern and western races (though more often in the former), individuals are found in which the lancet is almost cuneate, as in *affinis*.—These two individual variations are worth noticing, as, both of them, pointing back to *affinis*.

The ears are somewhat modified: more attenuated below the tip, and more pointed.

The plagiopatagium is inserted on the tarsus, on the base of the metatarsus, or about 1 mm. above the ankle-joint. But in one individual (from Cyprus) it is inserted no less than 6 mm. in front of the ankle-joint. It, again, recalls *Rh. affinis*.

Colour. A small series of skins from Tessin, Switzerland, affords some information as to the *difference in colour dependent on the age of the individuals*; all the specimens are of the same sex, from the same locality, and the same month:—

(1) Two full-grown, but *younger* individuals (females, December); distal epiphyses of metacarpals ossified, but teeth unworn; they are probably about six months old:—Upper side

* According to Blanford (J. A. S. B. lvii. pt. ii. no. 3 (1888) p. 263), *Rh. tragatus* Hodgs., regarded by him as a distinct species, and corresponding to what is here called the eastern races of *ferrum-equinum*, has three mental grooves, *ferrum-equinum* one only. If this were so, I should have no objection to separating *Rh. tragatus* specifically from *ferrum-equinum*. But there is, in this as in other respects, a complete intergradation. The details are these:—(1) "*Rh. tragatus*" (10 spirit-specimens): in three individuals (Kashmir, Almora, Darjeeling) the three grooves are perfectly distinct; in three (Masuri, Nepal) the lateral grooves are less distinct than the central one; in two (Nepal) they are so far on the way towards obliteration that it requires close examination to discover them; in the two remaining (Shanghai) they are still more reduced. (2) *Rh. ferrum-equinum* (*s. str.*): rather often traces of the lateral grooves are easily observable; a number of individuals before me, from various places in Europe and W. Asia, have either a slight depression or a short linear groove on either side of the central one; in a specimen from Tübingen (one instance only, among several) they are at least not *more* obliterated than in two "*tragatus*" from Nepal and two "*nippon*" from Shanghai.

greyish "drab," lighter on the head and neck; base of hairs "ecru-drab"; a strongly marked, dark brown horse-shoe patch; under side almost "ecru-drab" on throat and breast, very light "drab" on belly.

(2) One (female, December); teeth almost unworn; must be very nearly of the same age as (1):—Intermediate in colour between (1) and (3), but nearer to (3).

(3) Three *aged* individuals (females, December); teeth worn; two of them are at least 1½ years old, the third (teeth very much worn) still older:—Upper side, a shade of brown which might be described as "mars-brown" with a pronounced tinge of "drab"; base of hairs light "ecru-drab"; scarcely any indication of a horse-shoe patch; under side light "wood-brown" with a tinge of "ecru-drab."

In a series from the Hautes-Pyrénées (January) I find the same differences in colour, but have not been able to verify the comparative age of the individuals by means of the skulls.

Three skins from Minorca (spring) are like the aged Swiss individuals or, if anything, a trifle lighter. The teeth are worn, showing the animals to be, probably, at least about two years old.

Skins of aged individuals from England are indistinguishable from Swiss specimens of a like age. A very young (not full-grown) example from Somerset is quite like the younger (greyish-drab) individuals from Switzerland.

As a general conclusion: young individuals are, broadly speaking, dark grey, old individuals brown; the colour of the young animal is retained, at least in some individuals, till December, beyond the time when the epiphyses of the metacarpals have become ossified. For those who have an opportunity to watch these Bats in the caves during the winter, it would be an object of some interest to ascertain how the colour-change is effected, by a moult or by a recolouring of the hairs.

Skull. The *essential* characters as in *Rh. affinis*, the *general shape* hardly different, but as a rule, of course, the skull is larger. The four anterior swellings are slightly more differentiated; the median ones almost circular in outline, the lateral ones oblong. Chief character: the much longer palatal bridge: very nearly ⅓ the length of the maxillar tooth-row, a little more or less, but never so short as ¼ the tooth-row (as in *affinis*).

Dentition. p_3 external and exceedingly small, or, *very often, lost*, also in younger individuals. p_2 and p_4 in contact. p^2 *completely external*, extremely small, *not rarely lost*, also in younger individuals. Upper canine and p^4 not only in contact, but their *cingula*, as a rule, *considerably overlapping* each other (the cingula of p^4 being external to that of the canine).

Measurements. On p. 115.

Distribution. From S. China and Japan, through the Himalayas, the Mediterranean Subregion (exclusive of Egypt), and Central Europe to S. England.

Geographical races. There are, at least, six forms of *Rh. ferrum-*

equinum, three eastern (*nippon*, *tragatus*, *regulus*), and three western (*proximus*, the typical form, and *obscurus*). They are sufficiently differentiated to need technical names, but in no respect—in the external characters, in the skull, in the dentition—is there a *sharp* "hard-and-fast" line between them:—

In the extreme east (S. China and Japan) we find a Bat (*nippon*) of moderate size and with rather small teeth; the dentition, too, has remained on a rather primitive stage of development; but the horse-shoe and nasal swellings are very broad. Some of these peculiarities, viz. the broad horse-shoe and nasal swellings, are preserved in the Central Himalayan *tragatus*, but the general size of the animal is increased, the skull and teeth very large, the dentition more highly developed. This latter character reaches a climax in the next form, *regulus*, from the N.W. Himalayas, but at the same time the horse-shoe and nasal swellings are markedly narrower; in this respect *regulus* evidently shows tendencies towards the western races, as also might be expected from its habitat.—These three Bats constitute what I call the "eastern" races of *ferrum-equinum*. The geographical line separating them from the western races must be drawn somewhere between Masuri and Gilgit, at the border between the Oriental and Palæarctic Regions. East of that line the individuals are *generally* larger, with broader horse-shoe; the lateral mental grooves *not rarely* fully developed; the tail on an average only $1\frac{1}{3}$ the length of the lower leg.

Passing from Masuri (still *regulus*) to Gilgit, on the extreme north-western, "Palæarctic" side of the Himalayas, we find a form (*proximus*) with small and slender skull, narrower horse-shoe and nasal-swellings; which give it a decidedly "western" aspect, and contrast it with its eastern neighbour, *regulus*; but it has retained the somewhat shorter tail characteristic of the eastern races. The typical form has got rid also of this reminiscence, but, as a matter of fact, also in this race now and then, though rarely, individuals occur which "fall back" to the shorter-tailed eastern stage. The typical form leads to the generally smaller, extreme south-western race (*obscurus*: Spain, Algeria).

A closer study of these races, as compared with the Ethiopian *Rh. augur* and *Rh. deckeni*, will throw some light on the past history of the *ferrum-equinum* type (see the "General Remarks" on the *simplex* group, below, p. 118).

14 *a*. RHINOLOPHUS FERRUM-EQUINUM NIPPON Temm.

Rhinolophus nippon Temminck, Mon. Mamm. ii. 8^{e} monogr. (1835) p. 30 *a*; Temminck & Schlegel, Fauna Japonica (1842), p. 14, pl. iii. figs. 1, 2; Peters, MB. Akad. Berlin, 1871, p. 312.

Rhinolophus ferrum-equinum (partim) Dobson, Cat. Chir. Brit. Mus. (1878) p. 119.

Diagnosis. Size moderate, horse-shoe very broad. Skull small, but with rather broad nasal swellings; tooth-rows very short.

Details.—(1) Compared with *tragatus*: On an average (as a rule also absolutely) markedly smaller: forearm 57·2–59·3 mm. (*tragatus*: 59–63); but the horse-shoe is, nevertheless, of the same excessive breadth: 9–9·5 mm. (*tragatus*: 8·8–9·7). Skull considerably smaller and narrower, but (in conformance with the broad horse-shoe) with rather broad nasal swellings: *comparatively* as broad as in *tragatus*, but, owing to the smaller size of the skull, not absolutely so. Teeth markedly smaller, the tooth-rows shorter.

(2) Compared with *regulus*: Of approximately the same size (or *nippon* rather smaller), but horse-shoe considerably broader: 9–9·5 mm. (*regulus*: 8·2–8·8). Skull generally smaller and narrower, but nasal swellings, nevertheless, quite as broad as in *regulus* (comparatively, therefore, decidedly broader). Tooth-rows markedly shorter.

(3) Compared with the western races: The broad horse-shoe prevents it from being confused with any of the western forms.

Colour. As in adult individuals of *ferrum-equinum* from Europe *. No quite young specimens examined.

Dentition (5 skulls). In two skulls p_3 is present on both sides; in two (teeth unworn) on one side only; in one (teeth very slightly worn) lost, but the alveoli not quite obliterated. p^2 is present in all skulls examined. The cingula of the upper canine and p^4 not only less completely overlap than is generally the case in the other races, but in one skull the two teeth are very slightly, in one *quite distinctly, separated.* This dentition is decidedly more primitive than in the western neighbours of this race, *tragatus* and *regulus.*

Distribution. S. China (Shanghai). Pt. Hamilton. Japan.

Remarks. I find the examples from Shanghai and Pt. Hamilton (S. of Korea) indistinguishable from those from Japan.

14 *b*. RHINOLOPHUS FERRUM-EQUINUM TRAGATUS Hodgs. (Plate IV. fig. 14 *a*, *b*, *c*, *d*.)

Rhinolophus tragatus Hodgson, J. A. S. B. iv. no. 48 (Dec. 1835) p. 699; Peters, MB. Akad. Berlin (1871), p. 312.

Rhinolophus ferrum-equinum (partim) Dobson, l. s. c.

Diagnosis. Size largest, horse-shoe very broad. Skull and tooth-rows: the extreme.

Details.—(1) Compared with *nippon*: see this form, *supra.*

(2) Compared with *regulus*: On an average larger, with markedly broader horse-shoe (but no *sharp* line of separation, the maxima

* According to Temminck the fur of *nippon* is "plus long, plus abondamment feutré, plus soyeux et moins lustré" than in *ferrum-equinum* from Europe, and the colours "diffèrent également." In the length and abundance of the fur I am unable to find any tangible difference between *nippon*, *tragatus*, and *ferrum-equinum*. As to the colours (two well-preserved skins: Fuji and Nikko), it is quite the same as in darker individuals of *tragatus*, and this again as in fully adult individuals of the typical *ferrum-equinum*; laid side by side these Bats are indistinguishable in colour.

of *regulus* being equal to minima of *tragatus*). Skull generally larger, and with broader nasal swellings.

(3) Compared with the western races: The large size, broad horse-shoe, shorter tail, large skull, broader nasal swellings, and longer tooth-rows prevent it, in most cases, from being confused with any of the western forms.

Dentition. In one only, out of six pairs of mandibles, p_3 is present on both sides; in two (teeth unworn, or very slightly worn) on one side (alveolus disappeared on the other side); in no less than three completely wanting, although the teeth are either quite or almost unworn. A similar high development of the upper teeth (eight skulls): p^2 present in five; completely wanting, and alveoli disappeared, in three (teeth unworn or slightly worn). Cingula of the upper canine and p^4 always overlapping. This is unquestionably a higher stage than in *nippon*.

Distribution. Darjeeling. Nepal.

Technical name. Hodgson's cotypes of *Rh. tragatus* (three examples; Nepal) are in the British Museum.

14 *c.* RHINOLOPHUS FERRUM-EQUINUM REGULUS, subsp. n.

Rhinolophus ferrum-equinum Hutton, P. Z. S. 1872, p. 698.

Diagnosis. Size rather large, but width of horse-shoe moderate only. Skull large and broad, with long tooth-rows, but narrow nasal swellings.

Details. Compared with the western races: The large size, combined with the short tail, will, in most cases, make it readily distinguishable. The skull is, almost invariably, larger, the tooth-rows longer.

Dentition (4 skulls). In none of the skulls examined could I find any trace of the lower p_3, although they all have the teeth unworn. In two skulls p^2 is present, in two completely wanting. Cingula of the upper canine and p^4 always overlapping. *This is the highest stage of dentition* in any race of *ferrum-equinum* (in the present group it is surpassed only by *Rh. acrotis*, but this species is an Ethiopian modification not of the *ferrum-equinum* type, but of the *affinis* type).

Type. ♂ ad. (in alcohol). Masuri. Collected and presented by Capt. Hutton. Brit. Mus. no. 79.11.21.153.

Distribution. Almora. Masuri.

14 *d.* RHINOLOPHUS FERRUM-EQUINUM PROXIMUS, subsp. n. (Plate IV. fig. 15.)

Diagnosis. Size moderate, horse-shoe very narrow, tail short, Skull small and slender, with very narrow nasal swellings and short tooth-rows.

Details.—(1) Compared with the typical form: Although being of the same size as the larger and medium-sized individuals of the typical form, *proximus* has a very short tail; in so far, it might, very properly, be characterised as a "typical" *ferrum-equinum*

which has preserved the tail of the eastern races (*cf.* also its geographical habitat); the horse-shoe is remarkably narrow. The skull very small and slender; the nasal swellings narrow.

(2) Compared with *obscurus*: Larger, but *proportionately* with narrower horse-shoe. The skull is even smaller and more slender than in any individual of *obscurus* I have seen.

(3) Compared with the eastern races: The small size, combined with the very small horse-shoe, distinguishes it sufficiently. The skull is smaller and, especially, more slender, the nasal swellings narrower, than in any of the eastern forms.

Dentition (one skull). p_3 and p^2 present. Cingula of the upper canine and p^4 overlapping. This dentition is more in accordance with that of the typical *ferrum-equinum* than that of *regulus*, showing the "western" character of *proximus* (notwithstanding the short tail), a conclusion borne out by the general external aspect of this Bat, and the size of the skull and the tooth-rows.

Type. ♀ ad. (in alcohol). Gilgit. Presented by Dr. J. Scully. Brit. Mus. no. 81.3.1.10.

14 *e*. RHINOLOPHUS FERRUM-EQUINUM Schreb., TYPICUS.

Le fer-à-cheval Daubenton, Mém. Acad. Roy. Sci. Belg. 1759, pp. 377, 382, pl. 15. fig. 4.

Vespertilio Ferrum equinum (partim) Schreber, Säugthiere, i. (1775) pp. 174, 188, pl. 62 (the two upper figures).

Vespertilio equinus (partim) P. L. S. Müller, Natursyst., Suppl. (1776) p. 20.

Vespertilio Ungula (partim) Boddaert, Elenchus animalium, i. (1785) p. 71.

Vespertilio Ferrum equinum, a. major Gmelin, Linn. Syst. Nat. i. (1788) p. 50.

Vespertilio Hippocrepis (partim) Schrank, Fauna Boica, i. (1798) p. 64.

Rhinolophus uni-hastatus Geoffroy Saint-Hilaire, Descr. de l'Égypte, ii. (1812) p. 132; id., Ann. Mus. d'Hist. Nat. xx. (1813) p. 257, pl. 5.

Rhinolophus ferrum-equinum var. *germanicus* et var. *italicus* Koch, Jahrb. Ver. Naturk. Nassau, 1862–63, pp. 522, 523 *.

Rhinolophus ferrum-equinum (partim) Peters, MB. Akad. Berlin, 1871, p. 310; Dobson, Cat. Chir. Brit. Mus. (1878) p. 119.

Rhinolophus libanoticus, *conchifer*, et *rufescens* "Ehrbg. et Lichtst. Mspt." Peters, loc. cit. (1871) (nomina nuda).

Diagnosis. Size moderate, horse-shoe rather narrow, tail long. Skull rather small and slender, with narrow nasal swellings and short tooth-rows.

* Koch's two "varieties" of *ferrum-equinum* must have been based on too small a material, or there must be some mistake in his statements. That individuals from S. Europe, *i. e.*, Europe S. of the Alps (his "var. *italicus*"), should, generally speaking, be larger than those from Europe N. of the Alps (his "var. *germanicus*"), is at all events not correct. The statement that var. *germanicus* is "über den Rücken mehr braungrau oder aschgrau gefärbt," whereas var. *italicus* "stets in das Röthliche neigt," raises the suspicion whether Koch has not compared immature individuals from Germany with fully adults from Italy.

Details.—(1) Compared with *obscurus*: the subjoined particulars will make the difference evident:—

59 specimens of the typical form have been examined from the following localities:—Transcaspia (1); Euphrates Valley (3); Syria (2); Galilee (2); Cyprus (2); N. Bulgaria (1); Transsylvania (31); Hungary (1); Moravia (2); Dalmatia (2); Turin (1); Genoa (1); Sicily (2); Switzerland (Tessin and Geneva* 7); Tübingen (1).

Forearm, in these specimens, *on an average* 57·5 *mm.* In no less than 44, *i. e.* 75 per cent., the forearm measures 57 *mm. or more* (up to 60·3 mm.); in the remaining (and quite independent of the locality) less than 57 mm. (down to 53·5 mm.).

Of *obscurus* 31 specimens have been examined from:—Troubate, Hautes-Pyrénées (8); Cintra, Portugal (1); Madrid (3); Valencia† (12); Minorca (5); Algeria (2).

Forearm, in these specimens, *on an average* 55·5 *mm.* In no less than 25, *i. e.* 81 per cent., the forearm measures *less than* 57 *mm.* (down to 52·8 mm.); in the remaining between 57 and 58 mm. Although the series is smaller than that of the typical form, the facts here pointed out cannot be due to mere chance; the contrast is too well marked.

As a conclusion: in the typical form the forearm measures generally 57 mm. *or more*; in *obscurus* almost always less than 57 mm.; maximum of *obscurus* is but a trifle larger than the average size of the typical form.

(2) Compared with the eastern races: the proportionately longer tail prevents, in almost all cases, its confusion with any of these races. The skull is rather easily discriminated from that of *tragatus* and *regulus* (*cf.* measurements, p. 115), but I fail to find any point by which to distinguish it from the Japanese *nippon*.

British specimens. 13 specimens have been examined. *Forearm on an average* 55·4 *mm.*, i. e., British specimens of *ferrum-equinum* are on an average of the same size as the extreme south-western (Spanish) race, *Rh. f. obscurus* ‡. Of the 13 specimens, 2 only have the forearm 57 mm. long or more (up to 58 mm., quite as in *obscurus*); all the others between 53·8 and 56·2 mm. These indications require, of course, verification by a much larger series §.

Dentition (11 skulls). In seven skulls p_3 is present on both sides (teeth in very different stages of wear); in one, on one side only (teeth worn); in three (teeth almost unworn, or much worn) completely wanting (no alveoli). p^2 is present in all the skulls examined, two of which are of very aged individuals. Cingula of the upper canine and p^4 generally more or less overlapping, but in two skulls separated by an extremely small interspace. This dentition is almost exactly as in *nippon*.

* For the loan of some Bats from the neighbourhood of Geneva I am indebted to M. Ch. Mottaz.

† A very elaborate table of measurements of fourteen Spanish specimens was kindly sent to me by Prof. A. Cabrera Latorre, Madrid. These are the only examples, dealt with in this paper, not examined by myself.

‡ Compare with this *Rh. hipposiderus minutus*, below, p. 142.

§ To keep the typical form uninfluenced by the smaller British individuals, I exclude these latter from the table of measurements on p. 115.

Measurements of Rhinolophus ferrum-equinum *and subspecies.*

	nippon. 7 specimens, 5 skulls.		*tragatus.* 5 specimens, 8 skulls.		*regulus.* 4 specimens, 4 skulls.		*proximus.* 2 specimens, 1 skull.		*typicus.* 59 specimens, 11 skulls.		*obscurus.* 31 specimens, 4 skulls.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Ears, length	22·4	23·8	21·8	24·5	22	22·8	20·8	21·2	21	23·8	18	22
„ greatest breadth	15·2	17	16·8	18·8	15·2	17·1	15	15·2	15	16·8	13	15
Nose-leaves, total length	15·2	15·8	16·2	17·8	15	15·7	14	14·5	14·5	16·8	13·7	15·5
„ breadth of horse-shoe	9	9·5	8·8	9·7	8·2	8·8	7·7	8	7·8	8·8	7·7	8·5
Forearm	57·2	59·3	59	63	58·7	60	56·8	58	53·5	60·3	52·8	58
3rd metacarpal	37·2	38·8	37·2	40·3	37·3	38·2	36·2	37	34·8	40·2	34	38
III.[1]	19·3	21	20·5	23	19·3	21	19·1	20	18	20·2	15	19
III.[2]	21	32	32	34·5	30·2	32	28·5	29·5	27·2	32·2	27·2	32
4th metacarpal	41·8	44	42	45·1	41·8	43·5	39·8	40·5	38	43·7	37	41·5
IV.[1]	11	12	11·6	13·8	11·2	13·2	10·7	11·7	10·3	12·5	10	11·7
IV.[2]	18·2	19·5	20·2	22	18·7	20·2	18·5	19·5	17·2	20·2	16	20
5th metacarpal	43·1	45·3	43·5	47·3	42·2	44·5	40·8	41	39·4	44·7	38·5	42
V.[1]	13·7	14·5	14	15·8	13·2	14·7	13·1	13·1	12·5	15	12·2	14·5
V.[2]	15·7	17·5	18	19	16·8	17	15·8	17	13·3	17	13·3	17
Tail	31	36·8	34·8	37	31·5	35	31·5	34	34	41	27	37
Lower leg	24·2	26·3	25·6	27·6	23·5	25·8	25·2	25·2	23·8	27·2	23	24·3
Foot	12·7	14·5	13	14·3	12·8	14·2	10·3	11·2	11	13·2	...	...
Skull, total length	22·9	23·7	24·9	25·7	23·7	24·7	22	...	22·7	23·8	22·3	23·2
„ mastoid width	10·2	10·9	11	11·5	10·7	11·2	...	...	10·2	11	10	10·6
„ width of brain-case	9·6	10	10·2	11	9·7	10·5	8·8	...	9·5	9·9	9	9·3
„ zygomatic width	11·7	12·2	12·8	13·3	12·1	13	11·2	...	12·1	12·7	11·3	12·2
„ supraorbital length	5·2	6	5·2	5·7	5·7	6	5·2	...	4·8	6	5	5·5
„ width of nasal swellings	6·3	6·8	6·7	7·2	6·1	6·7	6	...	6·2	6·7	6·2	6·5
Mandible, length	15·8	16·8	17·8	18	16·7	17·2	...	...	15·6	17	15·3	15·9
Upper teeth	8·3	9	9·3	9·9	9·2	9·7	8·8	...	8·5	9	8·5	8·7
Lower teeth	9·3	9·8	10·2	10·7	10·2	10·7	9·3	...	9·2	10	9·2	9·5

Distribution. From Transcaspia and the Euphrates Valley through Southern and Central Europe, exclusive of the Spanish Peninsula.

14*f*. RHINOLOPHUS FERRUM-EQUINUM OBSCURUS Cabrera.

Rhinolophus ferrum-equinum obscurus Cabrera Latorre, Mem. Soc. Españ. Hist. Nat. ii. (1904) p. 257.

Diagnosis. Smaller than the typical form.

Details.—(1) Compared with the typical form: see above, p. 114.

(2) Compared with the Eastern races: the small size, combined with the narrow horse-shoe, make it readily distinguishable. The skull is apparently slightly smaller than in *nippon*.

Dentition (4 skulls). As in the typical form.

Distribution. Spanish Peninsula, with the Balearic Islands. Algeria *.

General Remarks on the Rhinolophus simplex *Group.*

The place of origin.—Of all the existing forms, the Australian *Rh. megaphyllus* is one of the most primitive in dentition. But it is very unlikely that the Australian Continent has been the place of origin of the group. *Rh. megaphyllus* is the only Australian species of the whole *genus*; this might suggest the assumption that it is an immigrant into the country, rather than an ancient inhabitant: secondly, Australia is the extreme eastern border for the group (as well as for the genus), no species being known from the islands to the east of the Continent; it would probably not be so, if Australia had been a centre of dispersal for the group: thirdly, *megaphyllus* has at least two characters which certainly are not primitive—the large nose-leaves, and (probably as a consequence of that) the rather broad nasal swellings: fourthly, *megaphyllus* looks extremely like an enlarged, *continental* representative of the Lombok species, *Rh. simplex* (just as *Rh. rouxi* is the larger, continental representative of *Rh. borneensis*). These arguments seem to support the conjecture that, not the Australian Continent, but the "Indo-Australian Transitional Tract," now broken up into numerous larger and smaller islands, and still inhabited by such very primitive forms as *simplex*, *truncatus*, *nanus*, *celebensis*, and *borneensis*, has been the centre from which the group spread eastwards and westwards.

Differentiation †.—The ancestral species seems to have divided into two branches, an eastern and a western. In the eastern, more primitive branch the sagittal crest does not reach quite so far forwards as a point corresponding to the middle of the orbit; in the western the temporal fossa is comparatively a little wider, and the sagittal crest produced forwards more or less beyond that

* The type of *Rh. f. obscurus*, in the Madrid Museum, is from Valencia, Spain. As will be seen, I take the name in a wider sense. Valencia specimens were separated by Prof. Cabrera, as a distinct subspecies, mainly on account of a difference in the ratio between the length and breadth of the horse-shoe. In a large series of *ferrum-equinum* from Europe and W. Asia there is, however, no small, and quite individual, variation in this respect.

† Compare the diagram on p. 120.

point. The geographical line separating the two branches coincides with the line separating the "Austro-Malayan" from the "Indo-Malayan" subregion (Celebes being a part of the latter). The eastern branch is, as yet, represented by four known species *Rh. simplex*, *megaphyllus*, *truncatus*, and *nanus*. The western by all the others.

The further evolution, from *borneensis* to *ferrum-equinum*, has been discussed above, and is summed up, in the briefest possible form, in the subjoined diagram (p. 120). But the sketch of this group would be deprived of some of its most instructive features if the Ethiopian species were left quite out of consideration. They belong to three closely related types:—

(1) *Ethiopian species of the* borneensis-stheno-rouxi *type.*—Far south in Africa, in Bechuanaland and Mashonaland, we find two small species, *Rh. denti* and *simulator*, described quite recently *. *They are the Ethiopian representatives of the* borneensis *type*: the same general shape of the skull; essentially the same dentition; the same parallel-margined sella, with a faint or almost imperceptible constriction at the middle; the same style of connecting process; the same proportionate length of the fourth and fifth metacarpals; even the same length of the tail, &c. But there are, in these species, three characters of especial interest, because they enable us to determine still more precisely their phylogenetic place: the nasal swellings (side view) are more projecting than in *borneensis*, but less than in *stheno*; III.^{2} is lengthened, and IV.^{1} somewhat shortened, as in this species,—proving that *they have originated from a Bat which had already traversed a part of the distance separating* borneensis *and* stheno. The dentition is on a slightly higher level than in *borneensis* and *stheno*, the only difference being that p^2, although still in the tooth-row (as in the Oriental species), shows a distinct tendency *towards* the external side.

In the extreme south of Africa (Cape Colony) we find a species, *Rh. capensis*, which, quite superficially, looks like an enlarged *Rh. simulator*. *It is an African representative of Rh. rouxi*: the skull is to such a degree that of *rouxi* that it would be hard to find any tangible difference, even the measurements being practically the same (on an average smaller than in *rouxi*); the nose-leaves (sella, process, lancet) are the same; proportionate length of fourth and fifth metacarpals, of tail and tibia, the same. But the dentition is somewhat more advanced: p^2 is generally external, but still, very often, a quite distinct interspace between the canine and p^4 indicates its former place; III.^{2} is somewhat lengthened. In short: *Rh. capensis* is a "*Rh. rouxi*" which in the wing-structure has taken a course *towards*, in the dentition very slightly *beyond*, the *affinis*-stage.

(2) *Ethiopian species of the* affinis-*type.*—On the coasts of the Red Sea we find a species, *Rh. clivosus*, first made known by Cretzschmar from Mohila in Arabia; I have seen examples from

* Thomas, Ann. & Mag. Nat. Hist. (7) xiii. (1904) p. 386; Andersen, *op. cit.* (7) xiv. (1904) p. 384.

the African coast of the Gulf of Aden. *It is the closest existing relative of the Himalayan Rh. affinis*: the same shape of the skull; the same shape of the sella, of the connecting process, of the ears; the same structure of the wings (also the same lengthening of III.[2]); the same proportionate length of the tail. But it is more advanced in dentition: p_3 is not only external (as in *affinis*), but very often lost; p^2, which in *affinis* is still in the tooth-row, is in *clivosus* external and very small. In short: *Rh. clivosus* is a "*Rh. affinis*" with *ferrum-equinum* dentition.

The *clivosus* type has found its way very far into the Ethiopian Region. *Rh. darlingi* *, from Mazoe to Angola, is a modification of this type (as proved by the skull), differing from *clivosus* in the more pronouncedly pandurate sella, the much broader horse-shoe, the much smaller ears, and, by far the most interesting, *in the shortening of the third metacarpal*. This last peculiarity is the same as that pointed out above, under *Rh. ferrum equinum*: in the wing-structure *Rh. darlingi* differs from *Rh. clivosus* quite in the same way as *Rh. ferrum-equinum* from *Rh. affinis*. It is a suggestive fact to find this peculiarity so exactly copied by the South-African species.

Rh. acrotis †, from Egypt and Erythrea, is, externally, very similar to *Rh. clivosus*; also the wing-structure is the same. But the tendency, in *clivosus*, towards an obliteration of p_3 and p^2 has been further developed by *acrotis*: it has completely lost both of these teeth, thus being, in this particular respect, the highest member of the whole group. *Rh. acrotis* is a "*Rh. affinis*" with a dentition still more advanced than in *ferrum-equinum regulus*.

(3) *Ethiopian species of the* ferrum-equinum *type.*—*Rh. augur* ‡ is widely distributed, in several geographical races, over the southern part of the Ethiopian Region: the Orange River tract, Natal, the Lower Zambesi. *It is the closest existing relative of Rh. ferrum-equinum*; the skull, the nose-leaves, the wing-structure are the same; but the dentition is a trifle less advanced, and the ears are smaller.

We find the *ferrum-equinum* type also further northwards in Tropical Africa (Mombasa): *Rh. deckeni*; the skull and dentition, and all external characters of any importance, are as in *augur*; but the horse-shoe is broader.

The area occupied by these two Ethiopian representatives of the *ferrum-equinum* type extends, broadly speaking, from the Orange River to Mombasa. It is completely cut off from any other region inhabited by that type of Bat; it forms a large enclave bordered to the north and west by vast tracts where no representative of *ferrum-equinum* occurs; we must go so far away from South and Equatorial Africa as the Euphrates Valley, Syria, and Algeria before meeting with the closest relatives of those Ethiopian species. Thus the question suggests itself, by which way the *ferrum-equinum* type reached Tropical Africa, and why its range there is now so peculiarly insulate. When

* Andersen, Ann. & Mag. Nat. Hist. (7) xv. (1905) p. 70.
† Andersen, *op. cit.* (7) xiv. (1904) p. 454; (7) xv. (1905) p. 73.
‡ Andersen, *op. cit.* (7) xiv. (1904) p. 380.

trying to answer this question, the following facts must be borne in mind:—Firstly, that all palæontological evidence is wanting, which detracts from what we know about the affinities and distribution of the now existing representatives of these Bats. Secondly, that the *ferrum-equinum* type is unknown in Egypt, as well as in the whole region of the continent north of British East Africa, and that we have no reason, of any kind, to believe that it ever existed there. Thirdly, that we have to account not only for the distribution of *Rh. augur* and *deckeni* as compared with the other members of the same section of the genus, but also for the presence in Tropical Africa of representatives of the *borneensis* and *rouxi* types, and, be it noticed, representatives which, without exception, are *more highly differentiated* than their Oriental allies. These facts, so far as they go, seem to allow of no other satisfactory explanation than this: the immigration of these Bats, as of so many other Oriental types in the Ethiopian fauna, has taken place by way of the broad tract of land which, as commonly supposed, in a geologically late period connected Southern Asia with the African continent. In the case of the *ferrum-equinum* type this explanation would make it evident, why it, though vastly distributed in South and Equatorial Africa, is absent from the whole north of the continent with the exception of the extreme north-western (Mediterranean) coast-region, which it, no doubt, has reached from South-western Europe, since the Algerian race is subspecifically indistinguishable from the Spanish form (*Rh. f. obscurus*). In the case of the *borneensis* and *rouxi* types it would account for the fact that they are common to the Oriental and Ethiopian Regions, but absent from the whole of the Palæarctic Region. And it would also account for the presence of the genus *Rhinolophus* in the Ethiopian Region, for, as I shall have to show later on in this paper, all the Ethiopian representatives of the genus are undoubtedly of Oriental origin.

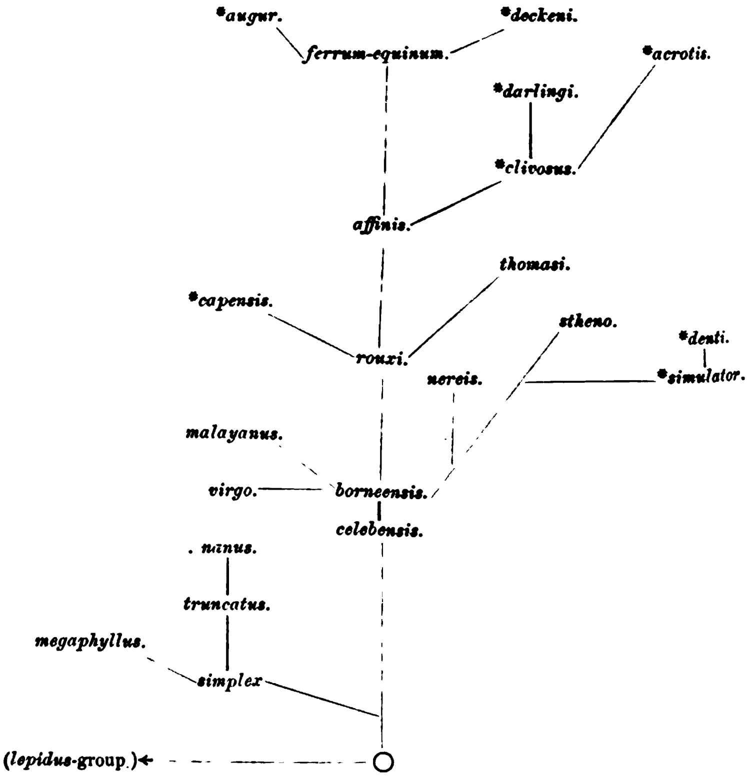
Such being the case, I am able to draw up the following rough sketch of the history of *Rh. augur*, *deckeni*, and their Oriental and Palæarctic relatives:—

The *ferrum-equinum* type has originated somewhere in South Asia; we find there the long series of more primitive forms which lead up to that type, whereas in the whole of the Ethiopian Region there is not any species with which it can be brought in genetic connection. The ancestral "*ferrum-equinum*" broke up into three branches: a south-western, a western, and an eastern. The south-western branch, which had spread directly from South Asia into the Ethiopian Region, was cut off from the main stem by the submergence of the connecting tract of land, and is now differentiated into two species—the southern *Rh. augur* and the northern *Rh. deckeni*. Both of them have retained at least two "ancient" characters: a slightly more primitive dentition (the upper canine and p^4 often more or less separated; p^2 sometimes half in row *) and a short tail. To the external difference

* 35 skulls of *Rh. augur* (all races) have been examined:—In 17 the upper canine and p^4 are more or less separated, in 7 in contact, in 11 more or less overlapping

between these two Ethiopian species, viz. a broad horse-shoe in *deckeni* and a narrow one in *augur*, we have a parallel in *ferrum-equinum*: a broad horse-shoe in *nippon* and *tragatus*, a narrow one in the other races. The western branch spread over South and Central Europe: the dentition slightly more advanced, the tail lengthened. The third branch is now represented by what I have called the Eastern races of *ferrum-equinum*; all of them have retained the short tail; *nippon* (which, so far as the dentition is concerned, has remained on a relatively less advanced stage) leads through *tragatus* to *regulus*, in which the dentition has reached the highest stage of development found in any race of *ferrum-equinum*.

According to this the mutual affinities of the species of the *simplex* group might be expressed as follows † (the Ethiopian species are marked with an asterisk):—



each other at base; *in 4 p^2 is half in row.* To this latter I find no parallel in any specimen of *ferrum-equinum* (all races) I have seen, and in 4 skulls only, out of 33, there is a more or less distinct remnant of the interspace between the canine and p^4. Of *Rh. deckeni* I have seen one skull only; the dentition is as in many specimens of *Rh. augur*: c and p^4 separated, p^2 external.

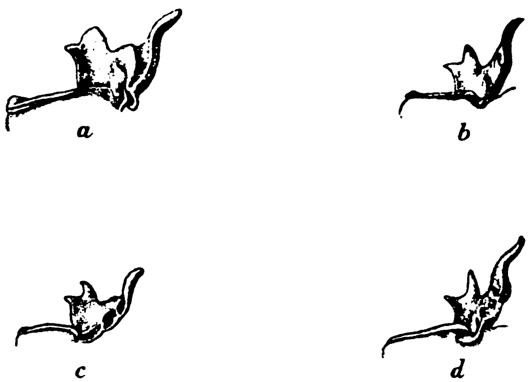
† I give the diagram the form of a genealogical tree, only because it is convenient to

II. The *Rhinolophus lepidus* Group.

Diagnosis. Basioccipital, between cochleæ, not unusually narrowed. Posterior connecting process projecting and pointed.

I include in this group:—(1) All the forms with projecting connecting process comprised by Dobson under the technical name "*Rh. minor*"; their close relationship is unquestionable; their differences will be pointed out below; (2) *Rh. acuminatus* and its allies, which are scarcely more than giant forms of the *lepidus*-type; (3) the *Rh. blasii* and (4) *Rh. euryale* sections, peculiarly modified Ethiopian and W. Palæarctic representatives of the *subbadius*-type. The two former sections only will be reviewed below; the two latter will be briefly mentioned in the "General Remarks" on the group (p. 135).

Text-fig. 22.



Side views of nose-leaves, showing the principal forms of the connecting process in the *Rh. simplex* group (*a*) and the *Rh. lepidus* group (*b*, *c*, *d*).

a. Rh. borneensis typicus; *b. Rh. cornutus pumilus*; *c. Rh. monoceros*; *d. Rh. empusa*.

As this is a first attempt to disentangle the many different forms hitherto confounded with Horsfield's *Rh. minor*, the following preliminary remarks are necessary, as a general guidance:—

The first of the above-named sections (the "*lepidus*-section"), viz., all the *small* Oriental and E. Palæarctic *Rhinolophi* which have the connecting process projecting and pointed, fall into three

show, at a glance, the probable interrelations of the species. As sufficiently emphasised in the foregoing pages, I am far from being of opinion that *ferrum-equinum* is derived from the *now-existing affinis* (or *capensis* from *rouxi*, or *stheno* from *borneensis*, &c.). But *ferrum-equinum* has originated from a Bat which had the more *essential* characters of *affinis* (besides several others, unknown to us). The technical names in the diagram are, in other words, to be taken, not in their strict specific sense, but as names of the *sections* ("types," "branches") of which the species, as we now see them, are the surviving representatives.

natural groups (sub-sections): the *lepidus*-type, the *minor*-type, and the *subbadius*-type.

I propose to characterise these types at once. It will enable me to confine the diagnoses of the various species to the points in which they differ from the subjoined general characteristic.

(1) The *lepidus*-type.—Chief characters: skull larger, width of brain-case about 7·7–7·8 mm.; connecting process (in side view) projecting as a small, erect triangle (not curved forwards as a sharply pointed "horn").

Description, based on *Rh. lepidus* (Wynaad, Mysore, Indian Peninsula).—Supplementary leaflet as in *simplex* and its allies. Horse-shoe not completely covering the upper lip; a small tooth-like projection on either side of the median notch; front border sometimes, not always, slightly crenulate (individual variation). Sella decidedly broader at base than at summit, slightly, but quite distinctly, constricted at middle, narrow at summit: there is a tendency towards producing an almost subacute summit to the sella (compare with this the *borneensis*-type: sella broadly rounded off, or even truncated, at summit); height of sella 3·2 mm.; width at base, at constriction, and at summit: 2, 1·8, and 1·2 mm. Connecting process projecting as an acute, sometimes only subacute, triangle beyond the summit of the sella. Lancet strongly hastate, about 3 mm. long. Three mental grooves.

Ears much as in the *celebensis-borneensis* type, but somewhat more blunt-tipped.

Wing-structure quite primitive, *i. e.* no lengthening of $III.^2$, this phalanx being always less, and very often much less, than $1\frac{1}{2}$ the length of $III.^1$; no shortening of the third metacarpal; fourth metacarpal slightly the longest (individually it may fall short of the fifth by a fraction of a millimetre). This wing-structure is perfectly like that of *Rh. simplex* and its allies.

Tail slightly longer than (individually equal to, or a trifle shorter than) the lower leg. Plagiopatagium inserted on the ankle, slightly above or below.

Skull. General shape: the *simplex-borneensis* type, but *considerably smaller, with smaller teeth, and shorter tooth-rows.* The orbital cavities (the confluent orbital and temporal fossæ) are shorter and narrower than in *borneensis*, the zygomatic arches, therefore, less projecting laterally, making the zygomatic width of the skull, as a rule, only equal to, or even a trifle smaller than, the mastoid width. These peculiarities combined make, as a rule, the skulls of the species of the *lepidus*-type rather easily distinguishable from those of the *borneensis*-type.—Arrangement of the nasal swellings, essentially, as in *borneensis*. Palatal bridge, on an average, somewhat less than $\frac{1}{3}$, but more than $\frac{1}{4}$ the length of the maxillar tooth-row.

Dentition. Position of p_3 (in, or external to, the tooth-row) "vacillating." p^2 invariably in the tooth-row. This dentition is precisely as in *simplex-borneensis*.

Species. Rh. lepidus, monticola, refulgens.

(2) The *minor*-type.—Chief characters: skull, also proportionately, very small; width of brain-case about 6·8–7·2 mm.; connecting process of the *lepidus*-type (text-fig. 22, *b*, p. 121).

Description, based on *Rh. cornutus pumilus* (Loo-choo Islands).—Nose-leaves as in the *lepidus*-type, but: sella narrower; height about 2·8 mm.; width at base, at constriction, and at summit: 1·7, 1·5, and 1·1 mm. Connecting process slightly higher, slightly more acute, but of the same general shape.

The other external characters as in the *lepidus*-type.

Skull. Considerably smaller; nasal swellings narrower. Teeth smaller.

Dentition. As in *lepidus.*

Species. Rh. minor, cornutus, "*minutus*" (Miller, nec Montagu), *gracilis.*

(3) The *subbadius*-type.—Chief character: connecting process long, slender, very sharply pointed, curved forwards, projecting like a small, curved "horn" (text-fig. 22, *c*, p. 121).

Nose-leaves, and other external characters, much as in *minor*, but connecting process as described above; lancet more or less approaching the shape of an equilateral triangle; length of sella about 2·4 mm.; width at base, at constriction, and at summit: 1·7, 1·3, and 0·9 mm.

Skull. To judge from fragments, and the skull of a quite young individual, much of the *minor*-type.

Dentition. As in *lepidus* and *minor.*

Species. Rh. subbadius, monoceros.

15. Rhinolophus lepidus Blyth.

Rhinolophus lepidus Blyth, J. A. S. B. xiii. pt. i. (June 1844) p. 486.

Rhinolophus minor (partim, nec Horsf.) Dobson, Cat. Chir. Brit. Mus. (1878) p. 114.

Diagnosis. Skull and external characters: *lepidus*-type. Larger: forearm 41·8–42 mm.

Details. This species differs from *Rh. monticola* in its broader nasal swellings, larger size, and considerably longer metacarpals.

Colour. Ad., skin: Ganges Valley; teeth almost unworn; two ♂ ad., in alcohol: Wynaad; teeth unworn. General colour above between "wood-brown" and "cinnamon," lighter on the anterior part of the back; base of hairs very light "ecru-drab"; under side "wood-brown" or tending to "ecru-drab."

Dentition (three skulls). p_3 external. p_2 and p_4 separated, or almost or quite in contact. p^2 in the tooth-row, with a well-developed cusp, pointing inwards.

Measurements. On p. 125.

Distribution. Indian Peninsula: Wynaad (Mysore); Ganges Valley.

Technical name. I identify this Bat with Blyth's *Rh. lepidus* (to which I find no reference in Dobson's 'Catalogue'), for the following reasons:—(1) *lepidus* belongs to this group of the genus,

as proved by Blyth's description of the connecting process, "still more developed [than in his *Rh. subbadius*] and obtusely angulated behind"; the words "still more developed" mean, evidently, "bigger," not extremely slender as in *subbadius*. (2) The types were "probably obtained in the vicinity of Calcutta"; one of the specimens in the British Museum is from the Ganges Valley, therefore in all probability from the very same locality as the types. (3) The colour, as described by Blyth, agrees very well with that of the specimens before me. (4) The forearm was stated to be "$1\frac{5}{8}$ inches" (41·5 mm.); the longest finger "$2\frac{1}{4}$ inches" (57·2 mm.); the tibia "above $\frac{5}{8}$ inch" (above 16 mm.); all these measurements are as in the British Museum examples: forearm 41·8–42 mm.; third finger 58·3–59·1 mm.; lower leg 16–17 mm. These facts leave no room for doubt as to the identification of *Rh. lepidus*.

16. RHINOLOPHUS MONTICOLA, sp. n.

Rhinolophus petersi (errore*) Hutton, P. Z. S. 1872, p. 700.

Rhinolophus minor (partim, nec Horsf.) Dobson, *ut supra*.

Rhinolophus subbadius (non Hodgs., nec Blyth) Scully, J. A. S. B. lvi. pt. ii. (1887) p. 244.

Diagnosis. Skull and external characters: *lepidus*-type. Smaller: forearm about 37·5 mm.

Details. This species differs from *Rh. lepidus* in its narrower nasal swellings, somewhat smaller size, and considerably shorter metacarpals. The horse-shoe seems to be narrower.

Colour. Unknown (faded in alcohol).

Skull. As in *Rh. lepidus*, but somewhat smaller, and with narrower nasal swellings.

Dentition (two skulls, one belonging to a quite young individual). p_3 in row (skull of an adult), or external (young). p_2 and p_4 well separated, or almost in contact. p^2 in row; a distinct cusp, pointing inwards.

Measurements. On p. 125.

Type. ♂ ad. (in alcohol). Masuri. Collected and presented by Capt. Hutton. Brit. Mus. no. 79.11.21.151.

17. RHINOLOPHUS REFULGENS, sp. n. (Plate IV. fig. 16 *a*, *b*, *c*.)

Diagnosis. Skull and external characters, essentially of the *lepidus*-type. But brain-case somewhat higher in front, making the anterior slope of the sagittal crest, towards the postnasal depression, somewhat more abrupt. Forearm 40·6–41·5 mm.

Details. Very nearly of the same size as *Rh. lepidus*, but metacarpals, also proportionately, somewhat shorter; tibia shorter. The horse-shoe is, if anything, slightly broader.

* There is no doubt that this is an accidental error. Prof. Peters (who determined Hutton's Bats) cannot, possibly, have identified the specimen here under consideration (forearm 37·5 mm.) with "*Rh. petersi*" (forearm of type 51 mm.). As already pointed out above (p. 97, footnote), the labels must have been confused; the name "*Rh. petersi*" was, probably, intended for Hutton's examples of *Rh. rouxi*.

Colour. ♀ ad., skin; Perak; March; teeth almost unworn. Very different from *Rh. lepidus.* General effect of the colour of the upper side: a dark shade of "Prout's brown" with a tinge of "hair-brown." On closer examination the fur of the upper side proves to be composed of two kinds of hair: longer, thinner, straight hairs, quite black; and somewhat shorter, crinkled hairs of a "hair-brown" colour; the mixture of the colours of these two kinds of hair produces the general effect. *Base of hairs of upper side not lighter coloured.* The fur of the upper side has a silvery reflection (iridescence). Under side between "broccoli-brown" and "hair-brown." A spirit-specimen from Selangor (♂ ad., apparently the same age) is of the same colour.

Skull. In addition to the characteristic in the diagnosis: the "maxillar width," across the antero-external corner of m^3 (a character subject to exceedingly small individual variation in the species of the *lepidus*-section) is somewhat larger, giving this part of the skull a somewhat broader aspect: 6·5–6·7 mm.; in *lepidus* 6·2 mm. Gap in front between the maxillary bones somewhat larger.

Dentition (two skulls). p_3 external. p_2 and p_4 almost or quite

Measurements of Rh. lepidus, monticola, *and* refulgens.

	Rh. lepidus.		*Rh. monticola.*	*Rh. refulgens.*	
	3 specimens, 3 skulls.		♂ ad. Type.	2 specimens, 2 skulls.	
	Min. mm.	Max. mm.	mm.	Min. mm.	Max. mm.
Ears, length	15·2	15·6	...	15·7	...
„ greatest breadth	11·5	12·2	...	12	...
Nose-leaves, total length	11·5	12	...	12·1	...
„ breadth of horse-shoe	7	7·2	? 6·2	7·5	...
Forearm	41·8	42	37·5	40·6	41·5
3rd metacarpal	30·8	31·2	28·7	28·3	29·2
III.[1]	10·8	11·8	10·9	10·8	11·5
III.[2]	15·8	16·1	14·2	14·2	15·3
4th metacarpal	31	31·2	28·8	29·2	30·2
IV.[1]	9	9·2	8·3	8·5	8·5
IV.[2]	10	10·2	9·8	9·5	10
5th metacarpal	30·7	31·6	28	28·8	29·7
V.[1]	9·8	10	9·2	9	9
V.[2]	9·8	9·8	9·8	10	10·2
Tail	17	18·3	...	16·7	19
Lower leg	16·6	17	15·3	15·9	16
Foot	8·3	8·7	7·7	8·3	...
Skull, total length	17·7	...	16·8	17·2	17·2
„ mastoid width	...	...	8·1	...	8·4
„ width of brain-case	7·7	...	7·7	...	7·8
„ zygomatic width	8·7	...	8·2	8·3	...
„ supraorbital length	4·5	5	4·4	4·8	5
„ width of nasal swellings	5	5	4·5	4·8	4·8
Mandible	11·1	11·5	11	11·4	11·8
Upper teeth	6·6	6·7	6·3	6·3	6·8
Lower teeth	7	7	6·8	6·9	7·1

in contact. p^2 in row; a small cusp, pointing inwards. In one specimen there is an extremely narrow space between p^2 and p^4 (the former place of p^3).

Measurements. On p. 125.

Type. ♀ ad. (skin). Gunong Igar, Perak, 2000 ft.; March 1898. Presented by A. L. Butler, Esq. Brit. Mus. no. 98.11.29.2.

Distribution. Malay Peninsula: Perak; Selangor.

18. Rhinolophus minor Horsf.

Rhinolophus minor Horsfield, Zool. Res. Java (1824), pl. [7], figs. C, D.

Rhinolophus pusillus Temminck, Mon. Mamm. ii. 8e monogr. (1835) p. 36, pl. 29. fig. 8, pl. 32. figs. 22, 23; Peters, MB. Akad. Berlin, 1871, p. 309.

Rhinolophus brevitarsus Blyth, Cat. Mamm. Mus. Asiat. Soc. (1863) p. 24 (nomen nudum) ("vicinity of Darjeeling").

Rhinolophus minor (partim) Dobson, *ut supra.*

Diagnosis. Skull and external characters: *minor*-type. Ears, tail, and tibia shorter. Forearm 37–38 mm.

Details. This species differs from *Rh. cornutus* by the shorter ears, tail, and tibia (*cf.* measurements). The forearm is, at least on an average, shorter.

Colour. ♂ ad., skin; Darjeeling; November; teeth unworn. General effect of the colour of the upper side very much as in *Rh. refulgens*, though perhaps not quite as dark; *base of hairs light*, "ecru-drab"; under side "ecru-drab," darker on the hinder belly and flanks.

Dentition (three skulls). p_3 in row, almost in row, or external. p_2 and p_4 well separated, or almost in contact. p^2 in row; a small cusp, pointing inwards.

Measurements. On p. 128.

Distribution. Darjeeling. Siam. Java (*cf.* remarks below).

Technical name. Horsfield's type of *Rh. minor* is in the British Museum.

Rh. pusillus *.—The figure of the head of *Rh. pusillus*, as given by Temminck, proves that he had before him one of the small species of what is here called the *lepidus* group (shape of connecting process, of sella, &c.). The only question is, therefore, to *which* species the name *pusillus* belongs. It would seem to be settled, beyond doubt, by Temminck's statement that the types were brought from Java. But Dobson, who examined these types in the Leiden Museum, gave the rather astounding information that they are "undoubtedly specimens of *Rh. hipposiderus*"! † There is only one answer: if so, an interchange of labels has

* Temminck, ut supra; Dobson, Cat. Chir. Brit. Mus. (1878) p. 117; id. Rep. Brit. Assoc. 1880, p. 175; Peters, MB. Akad. Berlin, 1880, p. 23.

† This is the source of the statement that *Rh. hipposiderus* should occur in Java; there is no other foundation. The range of *Rh. hipposiderus* has its extreme eastern limit in Gilgit (N.W. Himalayas); there is not a single reliable record of that Bat from the whole of the Oriental Region; and the species therefore cannot possibly turn up again in Java.

taken place in that Museum; for the Bat figured and described by Temminck as *pusillus* was certainly no *hipposiderus*; among all the small *Rhinolophi* existing it would be difficult to find a stronger *contrast* to *Rh. pusillus*, in the shape of the connecting process, than *Rh. hipposiderus*.

Remarks. From Java I have seen one old skin only (the type) and a fragment of the skull, representing the nasal swellings and the teeth. It is, of course, not sufficient to prove that the Java Bat is in all particulars identical with that from Darjeeling; but the nasal swellings, the teeth, the connecting process, the horseshoe, as well as the measurements of the wings and tibia, are the same. If not identical, they are, at all events, extremely closely related.

19. RHINOLOPHUS CORNUTUS Temm.

Diagnosis. Skull and external characters essentially as in *Rh. minor*. Ears, tail, and tibia longer. Forearm 38·8–41 mm.

Details. Cf. *Rh. minor*.

Distribution. Loo-choo Islands, and Japan proper.

Geographical races. There are two races of *Rh. cornutus*, slightly differing in the general size, in the length of the tail and tibia, and in geographical habitat.

19 *a*. RHINOLOPHUS CORNUTUS PUMILUS, subsp. n. (Plate IV. fig. 17 *a*, *b*, *c*.)

Rhinolophus minor (non Horsf.) Bonhote, Nov. Zool. ix. (1902) p. 626.

Diagnosis. On an average smaller: forearm 38·3–39·7 mm.

Details. See table of measurements, p. 128.

Colour. ♂ ad., ♀ ad., skins; March; teeth unworn. Fur strongly bicoloured, *i. e.* base of hairs strongly contrasting with the tip. *General effect* very much as in the adult *Rh. hipposiderus*. Upper side, anteriorly almost "broccoli-brown," posteriorly next to "Prout's brown"; base of hairs extremely light, almost white with a tinge of "ecru-drab." Under side "ecru-drab," darker on the flanks.

Skull. Quite of the *minor*-type. The teeth seem to be a mere trifle smaller.

Dentition (three individuals). p_3 external; p_2 and p_4 completely in contact. p^2 in row, but the space between the upper canine and p^4 narrower than in the *lepidus*-type and *Rh. minor*; cusp of p^2 so extremely minute as to be scarcely observable (teeth unworn), and the tooth itself a little reduced in size.

Type. ♀ ad. (in alcohol). Okinawa, Loo-choo Islands, March 16th, 1902. Presented by the Hon. N. C. Rothschild. Brit. Mus. no. 2.10.7.18.

Distribution. A skin (skull very incomplete) from Foo-chow (Swinhoe leg.; Tomes Collection) seems to be referable to this form.

19 *b*. RHINOLOPHUS CORNUTUS Temm., TYPICUS.

Rhinolophus cornutus Temminck, Monogr. Mamm. ii. 8^e monogr. (1835) p. 37; Temminck & Schlegel, Fauna Japonica, p. 14 (1842) pl. 3. figs. 3, 4; Peters, MB. Akad. Berlin, 1871, p. 309.
Rhinolophus minor (partim, nec Horsf.) Dobson, *ut supra*.

Diagnosis. On an average larger: forearm 39·2–41 mm.

Details. See table of measurements, below. To judge from three spirit-specimens, the plagiopatagium is inserted a little higher up on the tibia (1–3 mm. above the ankle) than in the foregoing forms of this group.

Colour. (1) Tsu-sima: ♂ ad., in alcohol, unfaded; September; teeth unworn. As *Rh. c. pumilus*. A young individual, from Tsu-sima, is still considerably darker.

(2) Japan proper: one skin, three spirit-specimens; teeth unworn. Very different; extremely like *Rh. lepidus*, if anything still a trifle lighter.

Skull. Quite of the *minor* type; measurements slightly larger.

Dentition (five skulls). p_3 almost in row (two), or external (three). p_2 and p_4 well separated (two), or almost in contact

Measurements of Rh. minor *and* cornutus.

	Rh. minor.		*Rh. cornutus.*			
	3 specimens, 3 skulls.		*pumilus.* 3 specimens, 2 skulls.		f. *typica.* 6 specimens, 5 skulls.	
	Min. mm.	Max. mm.	Min. mm.	Max. mm.	Min. mm.	Max. mm.
Ears, length	15	...	16	...	16	17·5
„ greatest breadth	...	...	12·3	...	12	13
Nose-leaves, total length	...	...	11	...	11·2	12·5
„ breadth of horse-shoe	? 7	...	6·2	...	6·4	6·7
Forearm	37	38	38·8	39·7	39·2	41
3rd metacarpal	26·8	27·5	27·7	28·7	28·2	29·8
III.^{1}	10	10·8	10·7	11·4	11·1	11·6
III.^{2}	13	14·5	12·7	13·2	14	14·8
4th metacarpal	28·1	29	27·7	29·5	28·8	30·7
IV.^{1}	7·8	8·5	8	8·7	8·5	9
IV.^{2}	9	9·8	8·7	9·2	9·9	10·3
5th metacarpal	26·8	28	27·7	29·5	29	30·9
V.^{1}	8·8	9	9	9·5	9·1	9·7
V.^{2}	8·8	9·8	8·5	9·2	10·2	11·3
Tail	15·5	...	18	...	21	22
Lower leg	15·2	15·5	16·2	17·2	17·8	18·4
Foot	...	...	8	...	8·3	9
Skull, total length	15·7	...	...	16	16	17
„ mastoid width	7·8	...	...	7·8	8	8·2
„ width of brain-case	7	...	...	7·2	7	7·2
„ zygomatic width	8	...	...	7·9	7·8	8
„ supraorbital length	4	4·1	3·8	4	4·5	4·7
„ width of nasal swellings	4	4·2	...	4·1	4	4·2
Mandible	10·4	10·4	10·2	10·4	10·5	11·2
Upper teeth	5·9	6	5·7	5·7	6	6·3
Lower teeth	6·2	6·3	6	6·1	6·2	6·8

(three); in none, completely in contact. p^2 in row; a well-developed cusp, pointing inwards. Upper canine and p^4 widely separated; in one skull there is a small interspace between p^2 and p^4 (the former place of p^3).

Distribution. Japan proper.

Remarks. In general size, as well as in the skull and dentition, the Tsu-sima Bat agrees with the typical form; but the colour is that of *Rh. c. pumilus* *.

20. RHINOLOPHUS GRACILIS, sp. n. (Plate IV. fig. 18 *a*, *b*, *c*.)

Rhinolophus minor (partim, nec Horsf.) Dobson, *ut supra.*

Diagnosis. Skull: the *minor*-type. Sella parallel-margined; tail extremely short. Very small: forearm 36·2 mm.

Details. This is an aberrant species of the *minor*-type. The connecting process is quite of the same shape as in the foregoing species (very different from that of *subbadius*). But the sella is parallel-margined, as broad at the summit as at the base; by means of a lens (probably not without) an exceedingly faint trace of a constriction can be observed; the summit of the sella is broadly rounded off, as in *borneensis*, not with a tendency towards a subacute shape, as in the foregoing forms of this group; length of sella 2·8 mm.; width at base 1·8 mm., at summit 1·7 mm. The lancet is, considering the small size of the Bat, remarkably long (4 mm.), with the lateral margins almost straightly converging towards the tip; it recalls the lancet of *Rh. midas* and *hipposiderus* (with which species *Rh. gracilis* has no very close affinity).

The tail is extremely short (13·5 mm.), shorter than the lower leg. Plagiopatagium inserted a trifle above the ankle.

The colour (a little faded in alcohol) has probably been rather like that of *Rh. lepidus.*

Skull. Quite of the *minor*-type.

Dentition (one skull). p_3 external. p_3 and p_4 distinctly separated. p^2 in row; cusp extremely minute (unworn).

Measurements. On p. 132.

Type. ♀ ad. (in alcohol). Malabar Coast. Purchased. Brit. Mus. no. 73.4.16.2.

21. RHINOLOPHUS SUBBADIUS Blyth.

Rhinolophus subbadius Blyth, J. A. S. B. xiii. pt. i. no. 150 (June 1844) p. 486.

Rhinolophus garoënsis Dobson, J. A. S. B. xli. pt. ii. no. 4 (Dec. 22, 1872) p. 337; id., Mon. Asiat. Chir. (1876) p. 48, text-figs. *a*–*c*; id., Cat. Chir. Brit. Mus. (1878) p. 115.

* I have examined a paratype of Gerrit S. Miller's *Rh. minutus* (Proc. Wash. Acad. Sci. 1900, p. 235), the type of which is from the Anambas Islands. It is an offshoot of the *minor*-type, but undoubtedly a distinct species, differing from *Rh. minor* (from Darjeeling) in having the brain-case decidedly higher in front, giving the skull, in side view, a very characteristic outline. The name "*minutus*" is, however, preoccupied by Montagu's "*Vespertilio minutus*," which is the British form of *Rh. hipposiderus*. Mr. Miller will rename the Anambas species.

Diagnosis. Subbadius-type (cf. p. 123). The smallest species in the genus: forearm 34·2 mm.

Details. The very characteristic shape of the connecting process, formed as a long, sharply pointed, slightly curved "horn," prevents the confusion of this (and the next-following) species with any of the foregoing forms. Also the shape of the lancet is peculiar: short, broad, almost as an equilateral triangle; but I doubt that this character, in a large series, will prove to be quite as safe a guide for the discrimination of the species as the shape of the connecting process; there is, in all species of *Rhinolophus*, a little more individual variation in the lancet than in other parts of the nose-leaves. The sella is, essentially, of the *minor*-type (not as in *gracilis*), much broader at base than at summit; below the constriction the margins are almost parallel, above the constriction slightly converging; *the summit somewhat more subacute* * than in any of the foregoing species; tip of sella bent forwards.

Plagiopatagium inserted a trifle above the ankle.

The colour (a little faded) is probably not very different from that of *Rh. lepidus*.

Skull. Unknown. I have seen a small fragment only; it seems to be of the *minor*-type.

Dentition (one example). p_3 external. p_2 and p_4 in contact. p^2 in row; cusp small, but distinct.

Measurements. On p. 132.

Distribution. Nepal (type locality). Garo Hills †. (The only example of this species in the British Museum is without exact indication of locality.)

Technical name. Hodgson's "*Vespertilio subbadia*" (J. A. S. B. x. pt. ii. (Nov. 1841) p. 908), from the "Central Region of the Himalayas," is a nomen nudum (no word of description). The head of this Bat is figured in his unpublished drawings (pl. 8. fig. 3); it is not a *Rhinolophus*, but a *Hipposiderus*, probably *H. bicolor* or an allied form.

* I emphasise this peculiarity (and, on the whole, enter into a detailed description of the sella), because it is this "pattern" of sella which has been carried to an extreme in some of the Ethiopian and W. Palæarctic representatives of the *subbadius*-type (*Rh. empusa* and *blasii*; cf. the "General Remarks," pp. 136–37).

† In Dobson's 'Monograph' and 'Catalogue' (l. s. c.) *Rh. garoënsis* (= *subbadius*) is recorded from Masuri. The species is very likely to occur there, only it must be said that till now there is no proof. Its alleged occurrence in Masuri can be traced back to two examples in the British Museum (Capt. Hutton) identified by Dobson with *Rh. garoënsis*. They are, however, *Rh. monticola*, differing in all important points (process, lancet, size) from his own original description of *garoënsis*. Quite as in the case of *Rh. petersi*: as Dobson had no longer access to the type, he lost the precise idea of it. Still later (Rep. Brit. Assoc. 1880, pp. 175–76) he gave up the separation of *Rh. garoënsis* as a distinct species, and then we arrive at the stage when all small Indian and E. Palæarctic *Rhinolophi* with a projecting process were called *Rh. minor*, irrespective of differences in the skull, the process, the sella, lancet, general size, and geographical habitat. What led Dobson to this conclusion was the fact that the position of the lower p_3 varies in individuals from the same locality (which, however, also is the case in all the more primitive species of the *simplex* group, as high up in the series as *Rh. affinis*), and he was quite right in arguing that, from an exclusively *taxonomic* point of view, this character had no value; but he overlooked the other and more important characters by which the members of his composite species differ from each other.

Blyth's *Rh. subbadius* (1844) from Nepal, erroneously believed by himself to be the same as Hodgson's *V. subbadia*, is a genuine *Rhinolophus*. The following analysis of the original description will make it evident that it is the species here under consideration: (1) The connecting process is stated to be "conspicuously developed, and pointed"; one of the chief characters of *subbadius*. (2) The lancet is but "slightly emarginated towards the point"; also one of its principal characters; for the salient point in the sentence is the word "slightly," as proved by a comparison with the immediately subsequent description of *lepidus*, in which the lancet is called "considerably emarginated towards the tip." (3) Forearm "1⅜ inches" (34·8 mm.); third finger "1⅞ inches" (47·6 mm.); these measurements, as being smaller than in any other species, and like those of the individual before me (forearm 34·2, third finger 46·4 mm.), settle the identification beyond all doubt.

Rh. garoënsis.—Dobson's *Rh. garoënsis* (1872) is evidently the same species as Blyth's *Rh. subbadius** (to which there is no reference in Dobson's 'Monograph' or 'Catalogue'). The two authors emphasise the same points:—(1) The connecting process is described by Dobson as "forming an acutely pointed elevation." (2) The lancet is a "broad, triangular, pointed process," or, as he says in his 'Monograph,' "almost an equilateral triangle"; both of these features are the same as already pointed out by Blyth. (3) The Bat is said to be "probably the smallest known species of the genus," the forearm measuring only 1·3 in. (33 mm.). (4) Width of horse-shoe 0·2 in. (5·1 mm.); a very narrow horse-shoe is also characteristic of the species (5·5 mm., as measured by myself). In the type of *garoënsis* p_3 is, according to Dobson, in the tooth-row; this is of no importance for the identification; the position of this tooth is "vacillating" in the whole *lepidus* section.

22. Rhinolophus monoceros, sp. n.

Diagnosis. *Subbadius*-type. Larger: forearm, in a *not full-grown* example, 38·2 mm.

Details. Connecting process (text-fig. 22 *c*, on p. 121) and lancet as in *subbadius*. Horse-shoe markedly broader. General size considerably larger. Tail proportionately longer.

The type, and only specimen known to me, is not full-grown (supraorbital crests still separated posteriorly; no saggital crest; metacarpals far from having acquired their full length). In the table p. 132 I give only those measurements which may be of some use for comparison with *Rh. subbadius*.

Dentition. p_3 external. p_2 and p_4 in contact. p^2 in row; cusp very minute.

Type. ♀ juv. (in alcohol). Baksa, Formosa; June 5th, 1893. Collected by Mr. P. A. Holst. Presented by Henry Seebohm, Esq. Brit. Mus. no. 94.2.4.1.

* This view was held by the late Dr. Blanford, who, however, put the names down as synonyms of *Rh. minor* (J. A. S. B. lvii. pt. ii. no. 3 (1888) p. 262; Fauna Brit. Ind., Mamm. pt. ii. (1891) p. 277).

Measurements of Rh. gracilis, subbadius, *and* monoceros.

	Rh. gracilis.	*Rh. subbadius.*	*Rh. monoceros.*
	♀ ad. Type.	♂ ad.	♀ juv. Type.
	mm.	mm.	mm.
Ears, length	15·7	14·5	...
„ greatest breadth	11	11·2	...
Nose-leaves, total length	11·2	10	...
„ breadth of horse-shoe	6·2	5·5	6·5
Forearm	36·2	34·2	38·2
3rd metacarpal	25	24·8	...
III.[1]	9·7	9·8	11·2
III.[2]	12	11·8	...
4th metacarpal	26·5	25	...
IV.[1]	7·7	7·2	8·8
IV.[2]	8·8	8·7	...
5th metacarpal	26·5	25	...
V.[1]	8·3	7·8	9·2
V.[2]	9·2	8·7	...
Tail	13·5	14	17·8
Lower leg	14·8	14·8	16·5
Foot	8	7·8	...
Skull, total length	15·7	...	...
„ mastoid width	7·7	...	...
„ width of brain-case	7	...	...
„ zygomatic width	7·7	...	...
„ supraorbital length	4·2	...	...
„ width of nasal swellings	4·2	4	...
Mandible, length	10	10·2	...
Upper teeth	6	6	...
Lower teeth	6·3	6·2	...

23. Rhinolophus acuminatus Peters.

Diagnosis. Connecting process of the *lepidus*-type. Sella parallel-margined. Forearm 47–51 mm.

Details. This species, together with *Rh. sumatranus* and *calypso* described below, form a small, well-marked section of the *lepidus* group, which might conveniently be termed the *acuminatus* section, confined to Java, Lombok, Sumatra, and Engano, and differing from all the foregoing species:—(1) in being very much larger; *Rh. lepidus* is in size like a *Rh. hipposiderus*; *Rh. sumatranus* like a small *Rh. ferrum-equinum*; (2) in being *a trifle* more advanced in dentition: there seems to be no "vacillation" in the position of p_3.

Sella in *Rh. acuminatus* practically parallel-margined; on very close examination an extremely faint indication of an expansion below the middle can be traced. Lancet strongly hastate.

The rest of the nose-leaves, the mental grooves, the ears, the wing-structure, the length of the tail, and the insertion of the plagiopatagium (on the ankle, or slightly above or below) as in *Rh. lepidus*.

Skull. Very much larger than in *lepidus*. There is no essential difference in the shape *.

Dentition (two skulls). p_3 external. p_2 and p_4 quite, or almost, in contact. p^2 in row; a minute cusp, pointing inwards.

Measurements. On p. 134.

Geographical races. There are two forms of *Rh. acuminatus*, differing in size and in geographical habitat.

23 *a*. RHINOLOPHUS ACUMINATUS Peters, TYPICUS.

Rhinolophus acuminatus Peters, MB. Akad. Berlin, 1871, p. 308; Dobson, Cat. Chir. Brit. Mus. (1878) p. 113.

Rhinolophus petersi (partim, nec Dobson 1872 et 1880) Dobson, op. cit. (1878) p. 114.

Diagnosis. Larger: forearm 50·5–51 mm.

Colour.—(1) Dark phase: ♂ ad., skin; teeth unworn. As *Rh. refulgens*.

(2) Russet phase: ♀ ad., in alcohol, unfaded; teeth unworn. "Cinnamon-rufous" above; base of hairs of the same colour; under side lighter.

Distribution. Java.

23 *b*. RHINOLOPHUS ACUMINATUS AUDAX, subsp. n.

Diagnosis. Smaller: forearm 47–49·5 mm.

Colour. Two adult females, in alcohol, unfaded; teeth unworn, or worn. As *Rh. refulgens*.

Type. ♀ ad. (in alcohol). Lombok. Collected by A. Everett, Esq. Brit. Mus. no. 97.4.18.16.

Remarks. This form ought perhaps to be separated specifically from *Rh. acuminatus*. The mandible is markedly shorter, the teeth a trifle smaller, the nasal swellings slightly narrower, the geographical habitat quite isolated from that of *Rh. acuminatus*. But the Bali form, still unknown, may perhaps connect them together.

24. RHINOLOPHUS SUMATRANUS, sp. n.

Rhinolophus petersi (non Dobson 1872 et 1878) Dobson, P. Z. S. 1880, p. 462 (specimen examined).

Diagnosis. *Acuminatus* section, but sella very distinctly expanded below the middle. Width of horse-shoe 8·3 mm. Forearm 51–51·2 mm.

Details. Chief characters:—(1) compared with *acuminatus*: the very different shape of the sella, as described above; width at base, at expansion, and at summit: 2, 2·4, and 1·7 mm.; (2) compared with *calypso*: the much narrower horse-shoe.

Colour. ♂ ad., in alcohol, unfaded; teeth unworn. Upper

* The skull of the species of the *acuminatus* section is much like that of *Rh. rouxi*. It can, however, always be discriminated by the broader nasal swellings. The mandible is, proportionately, longer.

side darker than "mars-brown," lighter than "burnt-umber"; base of hairs scarcely differing in colour; under side "russet." This looks like an intermediate stage between a "dark phase" and a "russet phase." A second specimen (Göttingen Museum) is, however, quite of the same colour.

Skull. As in *Rh. acuminatus*.

Dentition (one skull). p_3 external. p_2 and p_4 quite in contact. p^2 in row; a minute cusp, pointing inwards. The interspace between the upper canine and p^4 is narrower than in *acuminatus*.

Measurements. Below.

Type. ♂ ad. (in alcohol). Lower Langkat, Sumatra; 1898. Presented by Herr Gustav Schneider. Brit. Mus. no. 4.4.1.1.

25. RHINOLOPHUS CALYPSO, sp. n. (Plate IV. fig. 19 *a*, *b*, *c*.)

Rhinolophus affinis (non Horsf.) Thomas, Ann. Mus. Civ. Genova (2) xiv. (1894) p. 108.

Diagnosis. Similar to *Rh. sumatranus*, but horse-shoe much broader: 10·2 mm.; ears longer and much broader. Forearm 52–52·3 mm.

Measurements of Rh. acuminatus, sumatranus, *and* calypso.

	Rh. acuminatus.				*Rh. sumatranus.*		*Rh. calypso.*	
	f. *typica.* 2 specimens, 1 skull.		*audax.* 2 specimens, 1 skull.		2 specimens, 1 skull.		2 specimens, 1 skull.	
	Min. mm.	Max. mm.	Min. mm.	Max. mm.	Min. mm.	Max. mm.	Min. mm.	Max. mm.
Ears, length	18·5	...	18	19	18·7	19	19·5	21·5
„ greatest breadth	14	...	14	14·5	14·3	14·3	16·3	16·8
Nose-leaves, total length	14	...	14	14·8	14	16	16	16·8
„ breadth of horse-shoe	8·2	...	8·1	8·2	8·2	8·3	10·2	10·2
Forearm	50·5	51	47	49·5	51	51·2	52	52·3
3rd metacarpal	35·8	36·5	33·7	35·2	35·2	36·8	37	38·3
III.[1]	16·2	16·2	15	15	15·2	16·3	15	15·8
III.[2]	19·8	20·7	17·5	20	20	21	20·9	21·5
4th metacarpal	37·4	38·7	35·1	38·3	37·2	38	38·2	39·3
IV.[1]	11·2	11·8	9·7	10·5	11	11·7	10·3	10·8
IV.[2]	13	...	12	13	13	13·6	12·8	13·8
5th metacarpal	37·7	38·7	36	38·8	37·5	38·3	38·2	39·3
V.[1]	12·6	12·8	11·5	11·8	12·2	12·7	11·8	11·8
V.[2]	13·6	...	13	13·5	13·7	14·6	12·8	13·8
Tail	25	...	21·7	23·5	25·2	26·5	24·7	26·5
Lower leg	22·2	23	21	21·7	22·5	22·5	22·5	23·2
Foot	11·8		10·8	11	10·8	11	10·3	11
Skull, total length	......			21·2	......		21·6	...
„ mastoid width	......			10	......		10·2	...
„ width of brain-case	......			9·3	......		9·2	...
„ zygomatic width		11·4		11·2	.....		10·9	..
„ supraorbital length		5		5·3		5	5·4	...
„ width of nasal swellings		6·2		6		6·2	6·3	...
Mandible, length		16		14·8		15·8	15·2	...
Upper teeth		8·8		8·2		8·8	8·7	...
Lower teeth		9·5		9		9·5	9·2	...

Colour. ♂ ad. and ♀ ad., in alcohol, unfaded; teeth unworn. As *Rh. refulgens.*

Skull. As in *Rh. sumatranus*, but maxillar width, across the antero-external corners of m^3, narrower (8·1 mm., as against 8·6 in *Rh. sumatranus*).

Dentition. Essentially as in *Rh. sumatranus*, but the interspace between the upper canine and p^4 broader; p_2 and p_4 not quite in contact.

Type. ♂ ad. (in alcohol). Kifa Juc, Engano. Collected by Dr. E. Modigliani. Presented by Marquis G. Doria. Brit. Mus. no. 94.1.7.3.

General Remarks on the Rhinolophus lepidus *Group.*

The ancestral species.—The ancestors of the *simplex* and *lepidus* groups were very closely related. The latter had a projecting connecting process, a slightly smaller skull and teeth. But the general *shape of the skull*, the *dentition*, the nose-leaves, apart from the process and a very slight difference in the shape of the sella, the ears, the *wing-structure*, the length of the tail, and, we might even say, probably the size, were either identical or extremely similar in both of these extinct Bats.

The place of origin.—There can scarcely be any doubt that the *lepidus* group originated much farther westwards than the *simplex* group. If we regard Japan as a continental group of islands, and put aside Java, on account of its peculiar geological history, we still find, not only the most primitive, but in fact *all* the species of the *lepidus* section on the Continent. It is only the *acuminatus* section which has spread over the adjacent larger islands, one of which (Sumatra) has comparatively recently been continental, while another (Java), probably in a more remote period, seems to have been connected with some part or other of Indo-China; and only one form, still so closely related to the Java species as hardly to be specifically different, has found its way so far eastwards as Lombok. The hypothesis, therefore, cannot be called unfounded, that *of the two ancestral species, the ancient* "simplex" *and the ancient* "lepidus," *the former was Eastern* in range (Austro-Indo-Malayan), *the latter Western* (Oriental).

Differentiation *.—From a systematic point of view I found it convenient to divide the *lepidus* section into three "types"; I think that, phylogenetically speaking, there are two only: the *lepidus* and the *minor* type. The former, as coming nearest to *simplex* in the proportionate size of the skull and teeth, is, probably, the more primitive; it is now distributed over the Indian Peninsula (*lepidus*), the Himalayas (*monticola*), and Malacca (*refulgens*). The latter, the *minor*-type, has spread from the Himalayas (*minor*) eastwards through S. China to Japan (*cornutus*); it is represented on the now quite isolated Anambas Islands ("*minutus*"); its occurrence in Java is not surprising, considering

* Compare the diagram on p. 138.

the faunistic affinities of that island; and it has established itself on the western coast of the Indian Peninsula (*gracilis*). I have but very little doubt that now, when attention has been called to the differences of all these forms of the *minor*-type, it will be found also in other parts of the Indian Peninsula.

If any inference can be drawn from fragments of a skull and the external characters, the *subbadius*-type would appear to be an offshoot of the *minor*-type: already in *minor* and *cornutus* the process is a little sharper-pointed than in *lepidus*; in *subbadius* and *monoceros* this tendency is carried much further.

The skull of the species of the *acuminatus* section (Java-Lombok, Sumatra-Engano) is of the *lepidus*-type; the process too; the colour remarkably like that of *refulgens*. This leads me to suppose that *acuminatus* and its allies (*sumatranus*, *calypso*) are scarcely more than giant representatives of the *lepidus*-type.

It is the *subbadius*-type which, from a zoogeographical point of view, is by far the most interesting: it has spread southwestwards over a vast part of the Ethiopian Region, and westwards over the Mediterranean countries:—

(1) The *empusa*-type.—*Rh. empusa** and *blasii* have progressed further on the way already indicated by *Rh. subbadius*. They have the small skull and the small teeth characteristic of *minor-subbadius*; in the shape of the skull there is no essential difference; *the dentition is identically the same*; the process is that of a *subbadius*; *the sella is deltoid*, that is: the tendency, in the *subbadius*-sella (as emphasised above), towards assuming a subacute summit has been further developed; and we still see *the constriction at the middle of the sella*. But *empusa* and *blasii* are (as always the Ethiopian and W. Palæarctic species) in several points more highly developed: III.^{2} is lengthened (about, or more than, 1½ the length of III^1.); also IV.^{2} is very much longer (not far from twice the length of IV^1.). *Rh. empusa* is, however, an inhabitant of Nyasaland, far S. of the Equator, *Rh. blasii* of the Mediterranean Subregion; thus, the two extremely closely allied species are now separated by an enormous tract, where no relative appears to occur. As we now know that they are descendants of the Oriental *subbadius*-type, the explanation seems to be quite clear: one branch spread southwestwards, into the Ethiopian Region, and developed into *Rh. empusa* (slightly more primitive dentition; shorter ears, broader horse-shoe); another westwards into the Mediterranean countries, *Rh. blasii*. There is an instructive fact connected with these two Bats: I believe them to be comparatively recent intruders into their areas; *Rh. empusa* is known from one specimen only, from the very *East* of Tropical Africa; *Rh. blasii* is much more common in the *Eastern* Mediterranean tract, and still it does not seem to have reached Spain †.

* Andersen, Ann. & Mag. Nat. Hist. (7) xiv. (1904) p. 378 (there is a misprint on p. 380: the length of the mandible is 12·1, not 13·1 mm.).

† Not recorded in Cabrera Latorre's "Quirópteros de España," Mem. Soc. Españ. Hist. Nat. ii. (1904). I am also not satisfied that there is any reliable record from the African coast of the Mediterranean.

(2) The *landeri-euryale* type.—The Ethiopian *Rh. landeri* (Fernando Po, Gaboon), *Rh. lobatus* (Lower Zambesi to Mombasa), and *Rh. dobsoni* * (Kordofan) have the small skull and the small teeth characteristic of *minor-subbadius*; the same shape of the skull; *the same dentition* (no vacillation in the position of p_3); the process is that of a *subbadius*. In so far there is no difference at all between this section and the former (*empusa-blasii*). But in the shape of the sella and in a certain peculiarity in the wing-structure they have taken a course of their own:—We have seen, in the *simplex* group, a progressive development from a sella constricted at the middle, through a parallel-margined stage, to a pandurate sella; we have seen in the *lepidus* group, too, the constricted sella (*minor*) modified into the parallel-margined (*gracilis*); *the Ethiopian species* here under consideration *represent the* third and *final stage, the pandurate sella.* In addition to this: in all of them $IV.^1$ *is peculiarly shortened*: less than (extremely rarely, as a slight individual atavism, equal to) half the length of IV^2. As in *Rh. empusa* and *blasii*, $III.^2$ is lengthened.

Rh. euryale, from the Mediterranean Subregion, is so extremely closely allied to the above-named Ethiopian species that it shares with them *all* essential characters (even *the highly peculiar shortening of* $IV.^1$), with one exception: *it has retained the parallel-margined sella.*

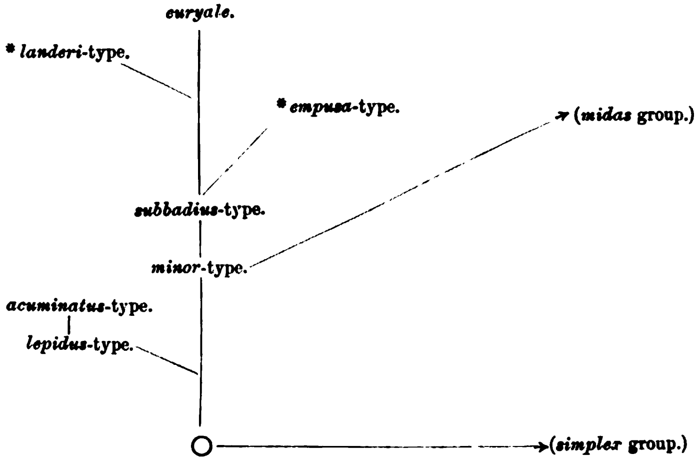
Summary.—When discussing the affinities of the Ethiopian species of the *Rh. simplex* group (above, pp. 117–20), I arrived at the conclusion that they are undoubtedly derived from Oriental types, and that, most probably, the ancestral species have spread directly from South Asia into the Ethiopian Region. As will be observed from this, a study of the Ethiopian representatives of the *Rh. lepidus* group leads to quite the same result: they have their closest known allies in the Oriental Region, but they are, without exception, considerably more highly developed than any of their Oriental relatives. Bats of the *subbadius*-type have evidently spread from some part of South Asia southwestwards into the Ethiopian Region (*empusa*; *landeri, lobatus, dobsoni*), and westwards over the Mediterranean countries (*blasii*; *euryale*). Of all the species of the *Rh. lepidus* group only one has found its way to Lower Egypt, *Rh. euryale*. It is a species exclusively Mediterranean in range, and unusually liable to differentiation into slightly differing local forms †. Its presence in Lower Egypt is easily explained by invasion from the adjacent Asiatic coast of the Mediterranean, where it is very common (specimens from Lower Egypt are indistinguishable from the Palestine form, *Rh. e. judaicus*) ‡.

* Thomas, Ann. & Mag. Nat. Hist. (7) xiv. (1904) p. 156.

† Andersen and Matschie, "Ueber einige geographische Formen der Untergattung *Euryalus*" (SB. Ges. naturf. Fr. Berlin, 1904, pp. 71–83).

‡ Although it is beyond the strict limits of the present paper, I propose to insert a few words on the remaining Ethiopian species of the genus:—The *æthiops* section (*Rh. æthiops, hildebrandti,* and *fumigatus*) are very closely related to the Himalayan *Rh. macrotis,* but much more highly developed in the dentition, the wing-

The probable affinities and phylogeny of the principal forms of the *Rh. lepidus* group are expressed in the subjoined diagram (Ethiopian types marked with an asterisk):—



III. The *Rhinolophus midas* Group.

Diagnosis. Cochleæ large, making the basioccipital, between them, extremely narrow (linear). Posterior connecting process very low and rounded off.

26. Rhinolophus midas, sp. n. (Plate IV. fig. 20 *a*, *b*, *c*, *d*.)

Diagnosis. Sella almost deltoid, summit rounded. Forearm 37·7 mm.

Details. Horse-shoe as broad as the upper lip; no "tooth" on the sides of the median notch; no crenulation of the border. Lateral margins of sella converging from base to tip; breadth at base (2·3 mm.) much more than half the vertical height of the sella (3·5 mm.); a very slight (rather easily overlooked) constriction at the middle; summit rounded (breadth 1·6 mm.). Connecting process very low, and broadly rounded off. Lancet long (4 mm.) and cuneate. One mental groove only.

Ears a little longer than in *minor*, outer margin immediately below the tip somewhat more emarginate; tip more distinctly pointed.

Wing-structure, compared with that of *minor*, considerably

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structure, and the mental grooves (Andersen, Ann. & Mag. Nat. Hist. (7) xvi. Sept. 1905, pp. 291–92). *Rh. maclaudi* is an Ethiopian representative of the *Rh. philippinensis* group, but on a considerably higher stage of development in the same respects as the species just named (*Id.*, *tom. cit.* Aug. 1905, pp. 254–55).

This completes the account, showing that *all the Ethiopian Rhinolophi*, without exception, *are of Oriental origin.*

modified, chiefly in two respects:—(1) *the third metacarpal is shortened*; but at the same time the fourth metacarpal has remained the longest (as in all primitive species of *Rhinolophus*); (2) III.^{2}, IV.^{2}, and V.^{2}, that is all the distal phalanges, are lengthened. Compare the table of measurements of *Rh. midas* and *hipposiderus* on the one side, with those of *minor*, *lepidus*, and all their allies on the other (see p. 143).

Tail rather long, 1½ the length of the leg. Plagiopatagium inserted on the ankle-joint.

Colour (somewhat faded in alcohol) probably as light as in *Rh. blasii*.

Skull. In all species of *Rhinolophus* the cochleæ are large, making a narrow basioccipital (compare the genus *Hipposiderus*); but in *Rh. midas* and *hipposiderus* the peculiarity is carried to an extreme: *the cochleæ are so much increased in size as to reduce the basioccipital to a linear bridge of bone*; in some individuals (of *Rh. hipposiderus*) the cochleæ are *almost* in contact. This character alone makes the skull of these two species easily distinguishable, at a glance. But in every other respect, in the shape, the size, and the teeth, the skull is so exceedingly like that of *Rh. minor*, that there can scarcely be any doubt as to the very close relationship of the *minor* and *midas* types.

Dentition. On the *minor* stage:—p_3 external. A very narrow interspace between p_2 and p_4. p^2 quite in row; a small cusp, pointing inwards. Upper canine and p^4 well separated.

Type. ♀ ad. (in alcohol). Jask, Persian Gulf. Presented by A. Butcher, Esq. Brit. Mus. no. 94.11.16.1.

Remarks. The discovery of this highly interesting species seems to remove all doubt as to the close affinities of *minor* and *hipposiderus*. The sella of *midas* is intermediate between that of *minor* and *hipposiderus*; it recalls that of *empusa* and *blasii*, which also are modifications of the *minor*-type; to the peculiarly long and cuneate lancet we have a parallel in one of the modifications of the *minor*-type described in this paper, viz. *Rh. gracilis*. The geographical habitat of *midas* is, too, rather intermediate between the Oriental *minor* and the W. Palæarctic *hipposiderus*.

Rh. midas is, of course, readily distinguishable from *Rh. hipposiderus* by the shape of the sella. In the width of the brain-case, as well as in external dimensions, it is like the *southern*, more primitive form of *hipposiderus* (*Rh. h. minimus*).

27. RHINOLOPHUS HIPPOSIDERUS Bechst.

Diagnosis. Sella cuneate; summit pointed. Forearm 34·7–41·7 mm.

Details. Breadth of sella at base never more, but generally less than half its vertical height.

Colour. (1) Younger, but quite full-grown individuals; skins; Cyprus, S. Carpathians, Switzerland. Very nearly "mouse-grey" above; horse-shoe patch faintly, or not at all, indicated; base

of hairs of the upper side and the whole of the under side "drab-grey."

(2) Aged individuals; skins; Cyprus, Malta, Balearic Islands, Switzerland, Germany. Much browner. General colour above brownish "drab," with some individual variation in the shade of the colour: sometimes almost "wood-brown" (lightest extreme), sometimes with a tinge of "Prout's brown" (darkest extreme); horse-shoe patch indicated, or quite obliterated; base of hairs "ecru-drab"; under side "ecru-drab," sometimes with a tendency towards "drab-grey."

Skull. As in *Rh. midas.*

Dentition. As in *minor* and *midas.* In the series of skulls examined (20; of all races) there is, of course, some variation in the position of p_3; the general rule is: p_3 external, p_2 and p_4 almost or quite in contact; one extreme: p_3 *almost* in row (one skull), and p_2 and p_4, therefore, well separated; the other extreme: p_3 not only external, but hair-fine (four skulls; teeth unworn), or disappeared and the alveoli obliterated (two skulls; teeth unworn).

Distribution. From Gilgit to Ireland; from the Baltic to Sennar.

Geographical races. The series examined—95 examples, from almost the whole area occupied by the species—enables me to recognise three races of *Rh. hipposiderus.* The first two of these would probably be called distinct species by other zoologists.

27 *a.* RHINOLOPHUS HIPPOSIDERUS MINIMUS Heugl.

Rhinolophus minimus Heuglin, N. Act. Acad. Cæs. Leop.-Car. xxix. (1861) p. 6.

Rhinolophus hipposiderus minimus Andersen, Ann. & Mag. Nat. Hist. (7) xiv. (1904) p. 455.

Diagnosis. Small: forearm 34·7–38 mm.

Details. As lately pointed out by me elsewhere (*l. s. c.*), v. Heuglin's *Rh. minimus*, first described from Keren in Erythrea (type in the Stuttgart Museum), is a well-marked geographical race of *Rh. hipposiderus*, differing from the Central European form by its considerably smaller size. At the same time I mentioned that the British Museum possesses an example from Sennar indistinguishable from the type specimen of *minimus.* A subsequent examination of the whole series of *Rh. hipposiderus* preserved in the British Museum has revealed the rather surprising fact that *Rh. h. minimus* is by no means confined to Keren and Sennar, but *generally distributed over the Mediterranean Subregion.*

It differs from the Central European form in being *in every respect smaller*; in some respects, as it seems, *absolutely* smaller, in others at least on an average. I find the length of the forearm to be the best means for a ready discrimination: in *minimus*, 34·7–38 mm.; in the typical form, 39–41·7 mm. For other details, *cf.* the measurements on p. 143.

The skull is markedly smaller, the nasal swellings a trifle narrower, the teeth slightly smaller.

Distribution. 32 specimens examined. As it is of some interest to have the range of this hitherto overlooked form exactly determined, I subjoin a list of the localities from which I have seen examples, together with measurements of the forearm; it might perhaps lead to further investigation:—

Keren (1, the type *): forearm 36·3. Sennar (1): 36·5. Cyprus (6): 34·7–37·7. Smyrna (1): 37·5. Malta (8): 36–37. Middle Italy (Ostia 2): 35·7–36·8. Corsica (1): 37·7. Haute Savoie and Geneva (2): 37·7–38. Balearic Islands (7): 36·2–37·6. Seville † (1): 37·7. Morocco (Tangiers 1): 37·7. Portugal (Cintra 1): 36·2.

Summary of Distribution:—The Mediterranean Subregion, southeastwards to Sennar and Keren. Be it noted: there is no record from Egypt (and, very likely, it does not occur there: *cf.* remarks on p. 143).

Remarks. In the whole series of *Rh. hipposiderus* examined (apart from the British specimens, of course) I have not found any individual which I could not easily refer either to the southern or the northern form. I have some reason to believe that in certain *border districts* (*e. g.* S.W. Switzerland; *perhaps* also Cyprus) the two forms *occur together*, perhaps side by side, but *intermediate examples* I have never seen. They will probably be found.

27 *b*. Rhinolophus hipposiderus Bechst., typicus.

Vespertilio Ferrum equinum (partim) Schreber, Säugthiere, i. (1775) pp. 174, 188, pl. 62 (lower fig. only).

Vespertilio equinus (partim) P. L. S. Müller, Natursyst., Suppl. (1776) p. 20.

Vespertilio Ferrum equinum, β. minor, Gmelin, Linn. Syst. Nat. i. (1788) p. 50.

Vespertilio Hippocrepis (partim) Schrank, Fauna Boica, i. (1798) p. 64.

Vespertilio Hipposideros Bechstein, in Pennant's Allg. Uebers. vierfüss. Thiere, ii. (1800) p. 629, footnote (compare also pp. 615 and 736).

Vespertilio hippocrepis Hermann, Obs. Zool. (1804) p. 18.

Rhinolophus bi-hastatus Geoffroy St.-Hilaire, Descr. de l'Égypte, ii. (1812) p. 132; id., Ann. Mus. d'Hist. Nat. xx. (1813) p. 259, pl. 5.

* For the loan of this specimen I am indebted to Prof. Dr. Kurt Lampert, Director of the Royal Natural History Cabinet, Stuttgart. The type is a young, but apparently fullgrown, individual. *All* other examples of *hipposiderus*, of all races, of which I give the measurements, are fully adult (distal epiphyses of metacarpals ossified).

† As I have seen only one example from Spain, I may mention that of the whole series examined by Cabrera Latorre, for his "Quirópteros de España," no Spanish specimen had the forearm *more* than 37·5 mm. (Mem. Soc. Españ. Hist. Nat. ii. (1904) p. 252). I am unacquainted with the *Rh. phasma* (allied to *hipposiderus*) described by Cabrera in the same paper.

Rhinolophus Hipposideros var. *typus*, *alpinus*, et *pallidus* (partim) Koch, Jahrb. Ver. Naturk. Nassau (1862–63) pp. 530–31 *.

Rhinolophus hipposideros (partim) Peters, MB. Akad. Berlin, 1871, p. 310; Dobson, Cat. Chir. Brit. Mus. (1878) p. 117.

Rhinolophus bihastatus var. *Kisnyiresiensis* Daday, Orvos-Term. Értes. x. pt. 3 (1885) p. 274.

Rhinolophus hipposideros var. *troglophilus* Daday, Magy. tud. Akad. Értekez. xvi. pt. 7 (1886) p. 8, figs. 1, 2.

Rhinolophus euryale helvetica Bretscher, Vierteljahrsschr. naturf. Ges. Zürich, xlix. (1904) p. 256 †.

Diagnosis. Large: forearm 39–41·7 mm.

Distribution. 33 specimens have been examined, from the following localities:—

Gilgit (1): forearm 39·8. Urmi, N.W. Persia (1): 39·8. Van, Armenia (2): 39·2–39·3. Cyprus (1): 39·6 ‡. N. Bulgaria (1): 39. Roumania (13): 39–41·2. Transsylvania (2): 40–41. S. Carpathians (1): 39·3. Hungary (1): 41·7. Schlangenbad (2): 40–40·1. Strassbourg (3): 39–40·1. Thurgau and Vallais (5): 40·2–41·7.

Summary of Distribution:—From the extreme N.W. Himalayas, through N.W. Persia and Armenia, over the whole of Central Europe N. of the Balkans and the Alps.

27 *c*. RHINOLOPHUS HIPPOSIDERUS MINUTUS Montagu.

Vespertilio minutus Montagu, Trans. Linn. Soc. ix. (1808) p. 162, pl. 18. figs. 7–8.

Diagnosis. Forearm 36·3–39 mm.

Details. English and Irish individuals of *Rh. hipposiderus* differ from the Central European form in being on an average (and nearly always also *absolutely*) smaller. The length of the forearm varies, in 30 adult specimens from England, Wales and Ireland, between 36·3 and 39 mm., the average being 37·6. In other words: *the average size of the British race is considerably below the minimum of the typical form, and almost exactly like maximum of* Rh. h. minimus.

Distribution. England, Wales, Ireland §.

Technical name. Till the close of the 18th century, the two Bats now called *Rh. ferrum-equinum* and *Rh. hipposiderus* were

* Koch's "varieties" are scarcely determinable, his descriptions being utterly vague and based upon such characters as are subject to individual variation or dependent on age; var. *typus* and *alpinus* belong, probably, to the Central European form; var. *pallidus* seems to be a mixture of this and the southern race.

† A glance at the measurements in Bretscher's paper is sufficient to show that what he takes to be "eine ausgesprochene Lokalform" of *Rh. euryale* is an ordinary, typical *Rh. hipposiderus*!

‡ I ought perhaps to mention that this example, the only *typical hipposiderus* I have seen from Cyprus, is a dealer's specimen; a Cyprus series collected and presented by Miss Dorothy M. A. Bate (*cf.* P. Z. S. 1903, ii. p. 342) are unquestionably of the Mediterranean form.

§ For details, *cf.* J. E. Kelsall, "The Distribution in Great Britain of the Lesser Horse-shoe Bat," The Zoologist, xlv. (1887) p. 89.

regarded as a large and a small variety of one species. In 1808, Montagu pointed out some of their distinctive characters, and proposed for the smaller species the name *Vespertilio minutus*, being evidently unaware that the two Bats had already twice been specifically separated—by Bechstein in 1800, and by Hermann in 1804. Montagu's name, as being antedated by "*hipposiderus*," was soon almost completely forgotten (it is not recorded in Dobson's Catalogue). The original description of *V. minutus* being, however, based on English specimens, the name is now available for the British race of *hipposiderus*.

Remarks. We are now able to form a much clearer idea of the past history of *Rh. hipposiderus*. It originated from a Bat allied to *Rh. minor*, somewhere in Asia, most probably near the western border of (if not within) what is now called the Oriental Region. From there it spread southwestwards into Africa, westwards through the Mediterranean countries to Central Europe and the British Islands. There is, to my knowledge, no record of *Rh. hipposiderus* from Egypt; if this is evidence that it does not occur, and has not occurred, there, it is at the same time a

Measurements of Rh. midas *and* hipposiderus.

	Rh. midas.	*Rh. hipposiderus.*					
	♂ ad. Type.	*minimus.* 32 specimens, 12 skulls.		*f. typica.* 33 specimens, 6 skulls.		*minutus.* 30 specimens, 2 skulls.	
		Min.	Max.	Min.	Max.	Min.	Max.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Ears, length	17	14	16	15	16·5	14·2	15·5
„ greatest breadth	13	10	12	11·3	12·8	11·1	11·8
Nose-leaves, total length	12·8	10·6	12	11·2	12·9	10	11·8
„ breadth of horse-shoe	7·3	6	6·8	6·5	7	6	6·7
Forearm	37·7	34·7	38	39	41·7	36·3	39
3rd metacarpal	24·2	22·2	25·7	24·8	27·3	22·8	24·9
III.[1]	11·8	11	12·8	12·7	14·2	11·6	13·2
III.[2]	18·8	15·7	19	17·7	19·7	16·3	18·7
4th metacarpal	27	25	29·2	28	30·2	25·7	29·1
IV.[1]	7·1	5·8	7·8	7	8	6·7	8
IV.[2]	12	10·9	13·2	12	14·1	11·7	13·2
5th metacarpal	25·8	23·5	27·7	27·2	29·7	24·7	28·2
V.[1]	8·9	7·9	9·2	9·1	10·5	7·2	9·8
V.[2]	12·2	11·2	13·8	12·8	14·3	12·5	14·3
Tail	24·5	23·5	27·7	26·2	30·3	23·5	27
Lower leg	16·2	16	17·8	17·8	19·9	16·3	18·5
Foot	7·6	7·2	7·8	7·5	8·5	7·5	8·7
Skull, total length	15·9	14·5	15·5	16	16·2	16	16
„ mastoid width	7·4	7·2	7·7	7·7	7·8	7·8	7·8
„ width of brain-case	6·4	6·1	6·5	6·8	6·8	6·8	6·8
„ zygomatic width	7·6	7·2	7·9	7·8	8	8	8
„ maxillar width	5·8	5·2	5·3	5·3	5·5	5·6	5·7
„ supraorbital length	4·5	4	4·5	4·2	5	4·3	4·4
„ width of nasal swellings	4·2	3·7	3·8	3·9	4	4	4
Mandible, length	10·8	9·5	10	10	10·2	...	10·2
Upper teeth	5·8	5·2	5·4	5·4	5·7	5·7	5·7
Lower teeth	6·2	5·6	5·8	5·8	6	5·9	6

proof that it did not reach Erythrea and Sennar from the Mediterranean, by way of the Nile Valley, but *via* the formerly existing, broad land-connection between S.W. Asia and N.E. Africa. The individuals which established themselves in Central Europe, N. of the Balkans and the Alps, gradually making their way as far north as the Baltic, developed into a distinct, larger race (*Rh. h. typicus*). The British colony, originally the extreme western offshoot of the larger form, but soon cut off from communication with the Continental main stem, also developed into a distinct race (*Rh. h. minutus*); it got the not unusual stamp of an island form: the smaller size; and so it came to occupy, *seemingly*, but neither phylogenetically nor geographically, a somewhat intermediate position between the northern and southern races of *hipposiderus*, between its immediate and its more remote progenitors.

It is worth noticing that *Rh. hipposiderus* is distributed over the whole of England, occurring also in several places in Ireland, whereas *Rh. ferrum-equinum* is confined to the extreme south of England, apparently not farther north than Essex, Gloucester, and Pembroke, and has never reached Ireland. It may indicate that of these two comparatively recent immigrants into the British Islands, *Rh. hipposiderus* was the earlier comer. This assumption seems strengthened by another fact. On the Continent *Rh. hipposiderus* goes farther northwards and considerably higher up on the mountains than *ferrum-equinum*. It is but reasonable to suppose that the more hardy species was also the first to make its way to England.

IV. Summary.

1. A progressive evolution is pointed out from the Austro-Malayan *Rh. simplex*, through a long series of Oriental forms, to the Western Palæarctic *Rh. ferrum-equinum* (pp. 76–120; *résumé* pp. 116–120).

2. A similar chain from the Oriental *Rh. lepidus* to the Western Palæarctic *Rh. blasii* and *Rh. euryale* (pp. 123–138; *résumé* pp. 135–138).

3. The Western Palæarctic *Rh. hipposiderus* has no closer known relative than *Rh. midas* from the coast of the Persian Gulf, which again can be traced back to the Oriental *Rh. minor* (pp. 138–144).

4. All the Ethiopian representatives of the genus *Rhinolophus* are of Oriental origin (pp. 117–120, 136–138).

5. The following 26 forms (14 species and 12 subspecies) are described as new, all of them Austro-Malayan, Oriental, or Asiatic-Palæarctic:—*Rh. simplex*, p. 76; *megaphyllus monachus*, p. 80; *nanus*, p. 82; *celebensis*, p. 83; *virgo*, p. 88; *nereis*, p. 90; *stheno*, p. 91; *rouxi sinicus*, p. 98; *thomasi*, p. 100; *affinis himalayanus*, p. 103; *a. tener*, p. 103; *a. macrurus*, p. 103; *a. superans*, p. 104; *a. nesites*, p. 104; *a. princeps*, p. 106; *ferrum-*

equinum regulus, p. 112; *f. proximus*, p. 112; *monticola*, p. 124; *refulgens*, p. 124; *cornutus pumilus*, p. 127; *gracilis*, p. 129; *monoceros*, p. 131; *acuminatus audax*, p. 133; *sumatranus*, p. 133; *calypso*, p. 134; *midas*, p. 138.

6. The following 10 forms, hitherto usually regarded as identical with other species, are shown to be distinct species or subspecies:—*Rh. truncatus* Peters, p. 80; *borneensis* Peters, p. 84; *rouxi* Temm., p. 93; (*ferrum-equinum*) *nippon* Temm., p. 110; (*f.*) *tragatus* Hodgs., p. 111; *lepidus* Blyth, p. 123; *cornutus* Temm., p. 127; *subbadius* Blyth, p. 129; (*hipposiderus*) *minimus* Heugl., p. 140; (*h.*) *minutus* Mont., p. 142.

7. The following names, hitherto usually regarded as indicative of distinct species, are referred to the lists of synonyms:—*Rh. petersi* Dobson, p. 95; *garoënsis* Dobson, p. 131.

EXPLANATION OF THE PLATES.

Plate III.

Rhinolophus simplex group; skulls; front views $\frac{2}{1}$, all other figures $\frac{1}{1}$.

Fig. 1. *Rh. simplex* (p. 76); Lombok; type of the species. Front view.
2 *a, b, c*. *Rh. megaphyllus* f. *typica* (p. 79); Cooktown; B.M. no. 3.8.3.3. Upper, lateral, and front views.
3. *Rh. nanus* (p. 82); Goram; type. Front view.
4 *a, b*. *Rh. celebensis* (p. 83); Makassar; type. Upper and front views.
5 *a, b, c*. *Rh. borneensis* f. *typica* (p. 84); Labuan; topotype; B.M. no. 65.5.9.15. Upper, lateral, and front views.
6. *Rh. malayanus* (p. 89); Biserat; topotype; B.M. no. 3.2.6.84. Front view.
7 *a, b, c*. *Rh. nereis* (p. 90); Siantan, Anambas; type. Upper, lateral, and front views.
8 *a, b*. *Rh. stheno* (p. 91); Selangor; topotype; B.M. no. 98.3.13.2. Lateral and front views.
9 *a, b, c, d*. *Rh. rouxi* f. *typica* (p. 93); Ceylon. Upper, lower, lateral, and front views.
10. *Rh. thomasi* (p. 100); Taho, Karin Hills; topotype; B.M. no. 90.4.7.9. Upper view.
11 *a, b*. *Rh. affinis himalayanus* (p. 103); Nepal. Lower and front views.
12. *Rh. a. tener* (p. 103); Pegu; type. Upper view.
13. *Rh. a. princeps* (p. 106); Lombok; type. Upper view.

Plate IV.

Rhinolophus simplex, *lepidus*, and *midas* groups; skulls; front views $\frac{2}{1}$, all other figures $\frac{1}{1}$.

Fig. 14 *a, b, c, d*. *Rh. ferrum-equinum tragatus* (p. 111); Nepal; one of the cotypes. Upper, lower, lateral, and front views.
15. *Rh. f. proximus* (p. 112); Gilgit; type. Upper view.
16 *a, b, c*. *Rh. refulgens* (p. 124); Perak; type. Upper, lateral, and front views.
17 *a, b, c*. *Rh. cornutus pumilus* (p. 127); Loo-choo Isl.; topotype; B.M. no. 2.10.7.2. Upper, lateral, and front views.
18 *a, b, c*. *Rh. gracilis* (p. 129); Malabar coast; type. Upper, lateral, and front views.
19 *a, b, c*. *Rh. calypso* (p. 134); Engano; type. Upper, lateral, and front views.
20 *a, b, c, d*. *Rh. midas* (p. 138); Jask, Persia; type. Upper, lower, lateral, and front views.

4. On Stridulating Hemiptera of the Subfamily *Halyinæ*, with Descriptions of new Genera and new Species. By Dr. E. Bergroth, C.M.Z.S., Tammerfors, Finland.

[Received April 1, 1905.]

In his paper "Zur Kenntniss der Stridulationsorgane bei den Rhynchoten," Handlirsch * has described three different kinds of stridulatory organs in the Rhynchota: the prosternal furrow of the Reduviidæ; the strigose ventral patches of the Division Tetyraria of the Scutelleridæ; and the, at that time, still incompletely known stridulating apparatus of the Corixidæ, of which Kirkaldy † has since given us a complete description and a probably correct interpretation. There is, however, one group of Rhynchota in which these organs have remained unknown to Handlirsch and all other zoologists, except the distinguished systematist Stål, who knew them without recognising their function. In his important paper "Bidrag till Hemipterernas systematik" ‡ he states that the Pentatomid genera *Platycoris*, *Niarius*, *Alphenor*, and *Oncocoris* have the following character in common: "segmentis ventris secundo et tertio latera versus vitta longitudinali nonnihil curvata, opaca, vix elevata, transversim densissime subtilissimeque strigosa, instructis." Although *Gilippus* is described in the same paper, Stål seems to have overlooked the fact that this genus possesses the same structure, and in the systematic arrangement he places *Oncocoris* far apart from the other genera above mentioned. In a subsequent memoir § he ascribes the same character to *Mecidea*, the species of which are mostly African, though it is also represented in India and the temperate parts of America. In a third work ||, finally, he gives "ventre anterius vitta laterali transversim strigosa vel rugosa instructo" to a group of genera comprising *Mecidea* Dall., *Platycoris* Guér., *Niarius* Stål, *Oncocoris* Mayr, *Gilippus* Stål, *Alphenor* Stål, and *Caridophthalmus* Assm. (*Allocotus* Mayr, præocc.). Mayr ¶ has also seen these organs in his *Oncocoris punctatus*, but simply mentions them as a "schwache Erhöhung," without having observed that they are strigose. That they were not quite unknown to Dallas and Walker, will be shown below. Distant ** has lately removed *Mecidea* from the Halyinæ, placing it together with a part of the genus *Niphe* Stål (*Aenaria* Dist. nec Stål) in a division which he names Mecidaria, without mentioning the transversely striolated ventral patches of *Mecidea* at all. This is, however, no systematic improvement, these two genera scarcely having anything in common except the

* Ann. Naturhist. Hofmus. Wien, xv. (1900) pp. 127–141.
† Entomologist, 1901, p. 9; Journ. Quekett Micr. Club, (2) viii. pp. 33–46 (1901).
‡ Œfv. Vet.-Ak. Förh. 1867, pp. 491–560.
§ Enum. Hem. ii. p. 17 (1872).
|| Enum. Hem. v. p. 34 (1876).
¶ Reise d. Novara, Hem. p. 46 (1866).
** Rhynch. Brit. India, i. p. 140 (1902).

more or less "elongated body." Berg* has described two new genera from the southern parts of South America, *Proczelicus* and *Lobepomis*, which he says are allied to the genera *Amaurochrous* Stål and *Oncocoris* Mayr; but judging from the descriptions it seems very doubtful whether they belong here, the more so as *Amaurochrous* does not appertain to the Halyinæ at all. Distant† has also described an African genus, *Crollius*, which he places near *Platycoris*, but as nothing is said in the description as to the presence or absence of the strigose ventral patches, its position is uncertain. It is said to have the "rostrum about reaching the *anterior* coxæ"; if this be correct, it scarcely belongs to the Halyinæ. Besides the seven genera referred to this group by Stål, there is one described genus which appertains to the same group, viz. *Commius* Stål. Stål overlooked the striolated ventral patches of this genus and therefore incorrectly placed it among the Pentatominæ s. str., near *Chalcocoris* Dall. For this division of the Halyinæ I propose the name Platycoraria; all its genera, except *Mecidea*, are Australian, two of them (*Oncocoris* and *Caridophthalmus*) extending to the Austro-Malayan region (New Britain, New Guinea, Timor, Flores, Ceram).

As Stål‡ calls the strigose ventral patches of the Tetyraria "*maculæ stridulatoriæ*," but only speaks of "*vittæ strigosæ*" in the Platycoraria, it is evident that he did not recognise their true nature in the latter division. A close examination of the ventral patches of the Platycoraria shows, however, that they are perfectly homologous to the strigose areas of the Tetyraria. As described by Handlirsch, the stridulatory organs of the Tetyraria are made up of two different parts—(1) the passive element, consisting of the strigose ventral patches; and (2) the active element, consisting of a series of minute wart-shaped tubercles, bearing a subapical tooth or bristle and placed on the inner side of the tibiæ. The ventral patches are straight and situate on each side of the median line of the fourth and fifth segments, sometimes extending to the third or sixth segment; they converge behind and the striæ are arranged longitudinally, being nearly parallel to the axis of the body. When the insect bends the tibia against the femur and again stretches it, the spinous tubercles of the tibia pass across the strigose surface of the venter, thus enabling the insect, by rapidly repeating these movements, to produce an audible sound. In the Platycoraria both the active and the passive parts of the stridulatory organ show the same structure as in the Tetyraria, but the ventral patches are usually comma-shaped, a little elevated and placed near the base of the venter, beginning with a rather broad base at the anterior margin of the second segment and proceeding, gradually tapering and curved inwardly, to the posterior margin of the third (rarely second) segment, where they end not far from the median line. The

* An. Soc. Cient. Arg. xxxii. pp. 234 & 236 (1891).
† Ann. & Mag. Nat. Hist. (7) vii. p. 21 (1901).
‡ Enum. Hem. iii. p. 3 (1873).

patches are transversely strigose in the basal part, but the striæ gradually become more oblique and are often practically longitudinal at the narrow end. From the position of the patches it is clear that the tibiæ cannot come in contact with them, and the active part of the stridulatory organ must be sought for elsewhere. I have found it on the inner side of the hind femur, where it consists of a number of very small spinous knobs arranged either in a single regular row or in two or three irregular ones. They are visible under a common pocket-lens, but under a compound microscope they present exactly the same structure as the tibial spinules of the Tetyraria. I propose to call them "*spicula stridulatoria.*" The movements of the femur exactly correspond to the different direction of the striæ of the ventral patches, these striæ being always crossed at a right angle by the "*spicula.*" By rubbing the inner side of the femur over the ventral patch I have experimentally produced a stridulating noise. Stål seems to have observed the "*spicula stridulatoria*" in *Platycoris* and *Niarius*, for in his above-quoted paper of 1867 he says they have the "femoribus posticis intus granulatis." In his larger work of 1876 he has omitted to mention it.

In his revision of the Hemiptera Heteroptera of the British Museum, Distant was apparently not satisfied with the state in which he left the genus *Dictyotus*. He says*: "*Dictyotus* requires revision; all the species which Dallas included in his genus do not appear to be congeneric." Without having seen Dallas's types I had myself, in determining some species of this genus, come to the same conclusion. In some of his specific descriptions Dallas speaks of "a curved raised line on each side of the second and third segments" of the venter. Walker has also described his *Mormidea detersa* as having the "abdomen beneath with a short curved smooth line on each side near the base." I therefore suspected that these particular species belong to the genus *Oncocoris*, and this supposition has proved to be correct, my friend Mr. Distant having at my request kindly re-examined the types of the British authors previously referred by him to *Dictyotus*. It is therefore necessary to give a complete revised list of the species of *Oncocoris*, which follows here, and which is essentially founded upon the communications received from Mr. Distant.

ONCOCORIS Mayr.

Verh. zool.-bot. Ges. Wien, xvi. p. 362 (1866); Reise d. Novara, Hem. p. 44 (1866).

Dictyotus Dall. List Hem. Brit. Mus. i. p. 139 (pro parte).
Tarba Walk. Cat. Het. Hem. Brit. Mus. i. p. 236 (1867).

1. ONCOCORIS APICALIS Dall. West Australia.
Dictyotus apicalis Dall. List, i. p. 141 (1851).

* Ann. & Mag. Nat. Hist. (7) v. p. 388 (1900).

2. ONCOCORIS CŒLEBS Fabr. Australia *.
Cimex cœlebs Fabr. Ent. Syst. iv. p. 111 (1794).
Oncocoris cœlebs Stål, Hem. Fabr. i. p. 23.

3. ONCOCORIS CONFINIS Dall. Australia.
Dictyotus confinis Dall. List, i. p. 143.

4. ONCOCORIS DETERSUS Walk. Ceram.
Mormidea detersa Walk. Cat. iii. p. 554 (1868).
Dictyotus detersus Dist. Ann. & Mag. Nat. Hist. (7) v. p. 388 (1900).

5. ONCOCORIS DIMIDIATUS Mont. Victoria.
O. dimidiatus Mont. Bull. Soc. Sc. Bucarest, xii. p. 291 (1903).

6. ONCOCORIS DISCOIDEUS Dall. North Australia.
Dictyotus discoideus Dall. List, i. p. 144.

7. ONCOCORIS FAVILLACEUS Walk. North Australia.
Tarba favillacea Walk. Cat. i. p. 237.
Dictyotus favillaceus Dist. Ann. & Mag. Nat. Hist. (7) iv. p. 434 (1899).

8. ONCOCORIS GENICULATUS Dall. South Australia.
Dictyotus geniculatus Dall. List, i. p. 142; Dist. l. c.
Dictyotus lineatus Walk. Cat. i. p. 181.

9. ONCOCORIS INSULANUS Bergr. New Britain.
O. insulanus Bergr. Rev. d'Ent. x. p. 202 (1891).

10. ONCOCORIS LETHIERRYI Mont. Australia.
O. lethierryi Mont. Bull. Soc. Sc. Bucarest, xii. p. 294 (1903).

11. ONCOCORIS MODESTUS Horv. New South Wales.
O. modestus Horv. Term. Füz. xxv. p. 601 (1902).

12. ONCOCORIS OVALIS Bergr., *infra*, p. 153. Queensland.

13. ONCOCORIS PUNCTATUS Mayr. New South Wales.
O. punctatus Mayr, Verh. zool.-bot. Ges. Wien, xvi. p. 362 (1866); Reise d. Novara, Hem. p. 46, tab. i. fig. 6.

14. ONCOCORIS SEMIMARGINATUS Westw. West Australia.
Pentatoma semimarginata Westw. Cat. Hem. Coll. Hope, i. p. 42 (1837).
Dictyotus semimarginatus Dist. P. Z. S. 1900, p. 810.

15. ONCOCORIS SIMILIS Dall. Tasmania.
Dictyotus similis Dall. List, i. p. 143; Dist. Ann. & Mag. Nat. Hist. (7) iv. p. 434 (1899).
Pentatoma truncatula Walk. Cat. ii. p. 311 (1867).

* Fabricius gives no nearer habitat; I possess examples of the species from Queensland.

16. ONCOCORIS SUBSIMILIS Mont. Victoria.
O. subsimilis Mont. Bull. Soc. Sc. Bucarest, xii. p. 293 (1903).

17. ONCOCORIS TRANSVERSUS Carp. Murray Isl.
Dictyotus transversus Carp. Proc. Roy. Dublin Soc. vii. p. 138, pl. xii. f. 1 (1891).

18. ONCOCORIS TRUNCATELLUS Walk. Australia.
Eysarcoris truncatellus Walk. Cat. iii. p. 558.
Dictyotus truncatellus Dist. Ann. & Mag. Nat. Hist. (7) iv. p. 434 (1899).

19. ONCOCORIS VENTRALIS Walk. North Australia.
Mormidea ventralis Walk. Cat. iii. p. 555.
Dictyotus ventralis Dist. Ann. & Mag. Nat. Hist. (7) iv. p. 434 (1899).

The species of *Oncocoris* are very similar in *facies* to those of *Dictyotus*, but, apart from the stridulatory patches, are easily distinguished by having the antenniferous tubercles visible from above and the metasternal orifice prolonged in a keel.

Before proceeding to describe some new forms of this group, I may remark that in *Oncocoris* and *Commius* the "*spicula stridulatoria*" are arranged in a single straight row, whilst in *Platycoris* and *Niarius* they are placed in two or three irregular rows. The other described genera of the group are unknown to me.

NIARIUS TRYONI, sp. n.

Ovatus, opacus, niger, subtiliter sat dense punctulatus, supra callulis minutis flavidis conspersus, vitta superiore posteriore et margine angusto laterali capitis, basi hujus subtus, basi articuli primi, tertii quartique antennarum, rostro (articulo ultimo excepto), limbo laterali prothoracis et partis basalis corii, epipleuris, macula prope angulos basales et apice scutelli, macula oblonga laterali intus rotundata segmentorum abdominalium, acetabulis pedibusque (annulo anteapicali femorum excepto) flavo-ochraceis, ventre medio impunctato, dilute piceo, nitido. Articulus primus antennarum apicem capitis haud attingens, secundus duobus ultimis unitis æquilongus, tertius et quartus subæque longi. Pronotum lateribus leviter sinuatum. Scutellum apice impunctatum. Hemelytra apicem abdominis attingentia, corio basin segmenti sexti connexivi superante. Segmentum genitale maris medio segmentis tribus præcedentibus unitis subæquilongum. (Pedes postici desunt.)

Long. ♂ 10 *mm.*

Queensland.

Allied to *N. illuminatus* Dist., but in Distant's species the

head, pronotum, and scutellum seem to be differently sculptured, and there is no annulation to the femora.

LEVENNA, gen. nov.

Caput longitudine latius, leviter convexum, apice rotundatum, marginibus anguste reflexis, ante oculos magnos globosos sinuatis, tylo et jugis æque longis, illo postice elevato, his antice valde approximatis, ocellis majusculis, in linea inter marginem posticum oculorum ducta positis, a linea media capitis quam ab oculis saltem duplo et dimidio longius distantibus, bucculis humilibus, rectis; rostro coxas posticas attingente, articulo secundo duobus apicalibus unitis breviore, tertio quarto longiore, tuberculis antenniferis e supero distinguendis, extus spinula porrecta armatis; antennis quadri-articulatis, articulo primo apicem capitis paullum superante, secundo longissimo. Pronotum medio capite parum longius, marginibus lateralibus anticis acutis, leviter explanatis et reflexis, angulis lateralibus haud prominulis, anguste rotundatis, angulis basalibus latissime rotundatis, margine basali recto. Scutellum pone medium leviter sinuatum. Mesosternum carinatum. Orificia metasternalia in rugam mediocrem continuata. Hemelytra apicem abdominis longe superantia, corio apicem abdominis subattingente (♂) vel hoc paullo breviore (♀), margine apicali levissime sinuato, angulo apicali acuto, membrana venis circiter sex instructa, exterioribus tribus furcatis et pone medium vena transversa conjunctis. Alæ apicem abdominis superantes, sed hemelytris paullo breviores. Abdomen hemelytris haud vel vix latius, subtus utrinque prope basin vitta stridulatoria curvata usque ad apicem segmenti tertii pertracta instructum, segmentis quinque primis ventralibus in mare medio valde retractis, quam lateribus fere triplo brevioribus, segmento sexto hujus sexus permagno, præcedentibus unitis medio longiore, angulis apicalibus hujus segmenti in mare latissime rotundatis, fere deletis, margine apicali recto, in femina obtusiusculis, margine apicali late arcuato-sinuato, segmento genitali maris latissimo, angulis apicalibus productis, margine basali sub segmento sexto ventrali subocculto, medio processu liguliformi verticaliter recurvo instructo. Pedes longiusculi, femoribus posticis intus spiculis stridulatoriis uniseriatis instructis; tibiis omnibus femoribus subæquilongis, superne sulcatis; tarsis triarticulatis, articulo primo tarsorum posticorum incrassato.

This remarkable genus is to be placed near *Commius* Stål, but is at once distinguished by the four-jointed antennæ, the very long hemelytra, and the enormously developed sixth ventral and genital segments in the male. The considerable length of the hemelytra is probably due to the necessity for preserving the inner parts of the very wide and open male genital segment from injury.

LEVENNA SALAX, sp. n.

Supra niger, sat dense et fortiter punctatus, linea longitudinali media plus minusve distincta verticis, vitta vel linea longitudinali media interdum medio late interrupta pronoti hujusque limbo laterali ab angulis apicalibus ultra medium interdumque etiam margine postico, macula parva ad angulos basales, maculis duabus mediis magnitudine variabilibus fasciaque subapicali scutelli, fascia corii ab angulo apicali interno ad marginem costalem ducta ibique dilatata segmentisque connexivi basi flavis, remote fusco-punctatis, venis membranæ præsertim apice sæpe pallescentibus. Alæ fusco-violaceæ. Caput subtus cum rostro et antennis violaceo-nigrum, bucculis sæpeque macula utrinque adjacente flavidis. Pectus violaceo-nigrum, limbo laterali prosterni ab apice ultra medium, carina media et margine laterali mesosterni ac limbo postico metasterni, interdum etiam acetabulis omnibus et prosterno medio, flavis. Abdomen subtus flavo-testaceum, disco medio interdum rufo-piceotincto vel segmento sexto medio macula fusca notato, limbo laterali ventris violaceo, macula quadrata ad angulos basales segmentorum flavida cum disco ventris interdum confluente signato. Pedes nigro- vel fusco-violacei, femoribus posterioribus interdum basin versus flavescentibus. Caput subtus et pectus remote punctulata, articulo secundo antennarum tertio fere dimidio vel saltem tertia parte longiore, tertio et quarto subæque longis. Pronotum longitudine media fere duplo et dimidio latius, marginibus lateralibus rectis. Abdomen subtus impunctatum, appendicibus duabus internis (lateralibus, Sharp) *segmenti genitalis maris longe subulatis.*

Long. ♂ 6–7·6 *mm., cum membr.* 8–9·6 *mm.* ♀ 7·8 *mm., cum membr.* 9·8 *mm.*

Queensland; South Australia (Yorketown).

COMMIUS MINOR, sp. n.

Flavus, capite (exceptis basi subtus, macula triangulari ab hac ad tubercula antennifera ducta bucculisque), maculis duabus magnis transversis triangularibus anticis pronoti, macula magna basali triangulari scutelli medium hujus attingente maculaque ejusdem angusta elongata marginali pone medium, meso- et metasterno medio (carina illius excepta), macula magna pleurarum, maculis quinque ventralibus, una utrinque sublaterali segmenti quarti et quinti et una magna media segmenti sexti, maculaque transversa segmenti genitalis maris violascenti- vel viridi-æneis, maculis duabus magnis basalibus basi contiguis pronoti fuscis, hemelytris subpurpureo-fuscis, opacis, levissime ænescentibus, corio fascia flava inter angulum apicalem internum et marginem costalem ornato; antennis, rostro pedibusque castaneis, his ænescentibus. Caput vertice medio et pone juga remote subtilissime punctulatum, jugis oblique strigosis, articulo secundo antennarum primo plus

quam dimidio longiore, tertio secundo tertia parte longiore (ceteri desunt). Pronotum medio capiti subæquilongum, remotissime et subtilissime punctulatum, marginibus lateralibus anticis subrectis. Scutellum remotissime et subtilissime, pone medium latera versus fortius punctulatum. Hemelytra apicem abdominis attingentia, clavo et corio remote subtiliter punctulatis, margine apicali hujus exterius levissime sinuato. Pectus remote punctulatum, pleuris medio lævibus. Abdomen impunctatum, segmento sexto ventrali maris medio segmentis tribus antecedentibus unitis æquilongo, segmento genitali maris margine apicali segmenti ultimi ventralis paullo latiore, appendicibus internis (lateralibus, Sharp) *falciformibus, dilute piceis (in* elegante *longioribus, nigris).*

Long. ♂ 9 *mm.*

Queensland.

Much smaller than *C. elegans* Don. and differently coloured, with the pronotum much shorter, the hemelytra also shorter, the apical margin of the corium much less sinuate near the apical angle, and the genital segment of the male much broader.

ONCOCORIS OVALIS, sp. n.

Ovalis, livido-testaceus, modice dense sat fortiter nigricanti-punctatus, ventre medio remote punctato, limbo laterali prosterni et ventris impunctato, articulo ultimo rostri, vitta angusta sublaterali paullo curvata dimidii antici pleurarum, macula oblongula ante angulos posticos prosterni, mesosterno medio (carina excepta), macula magna transversa basali ventris, macula media segmenti ejus sexti maculaque parva ad angulum basalem et apicalem segmentorum connexivi et ventris nigrinis. Caput pronoto medio subæquilongum, tylo et jugis æque longis, rostro coxas posticas superante; (antennæ desunt). Pronotum longitudine media duplo et dimidio latius, marginibus lateralibus subrectis, angulis lateralibus levissime eminulis, obtusis. Scutellum maculis quinque minutis basalibus et summo apice impunctatum. Hemelytra apicem abdominis superantia, corio areolis aliquot impunctatis prædito, membrana fusca, venis albo-cinerascentibus. Abdomen hemelytris subæque latum. Pedes maculis punctiformibus nigrinis conspersi, femoribus posticis medium segmenti sexti ventris paullum superantibus, spiculis stridulatoriis fusco-ferrugineis.

Long. ♀ 8 *mm.*

Queensland.

EURYNANNUS, gen. nov.

Corpus parvum, late breviter rotundato-ovale. Caput planiusculum, dimidio basali partis anteocularis antrorsum admodum angustato, lateribus obtusissimis, convexis, in tubercula antennifera continuo transeuntibus, dimidio ejus apicali parallelo, apice late rotundato et medio levissime inciso, lateribus acutis, jugis tylo longioribus et ante hunc contiguis,

oculis minutis, brevissime stylatis, ocellis perminutis, ab oculis ac linea media capitis subæque longe distantibus, mox pone lineam inter marginem posteriorem oculorum fictam positis, vertice oculo circiter septuplo latiore, tuberculis antenniferis e supero distinguendis, antrorsum convergentibus, apice extus spinuloso-productis; antennis ab oculis et ab apice capitis subæque longe insertis, quinque-articulatis, articulo primo apicem capitis haud attingente, bucculis humilibus, rectis; rostro coxas posticas paullum superante, articulo secundo apicalibus duobus subæquilongis unitis paullo breviore. Pronotum medio capiti subæquilongum, marginibus lateralibus anticis leviter rotundatis, antice leviter sinuatis, margine postico rotundato, angulis lateralibus vix eminulis, obtusis. Scutellum subæque longum ac latum, parte apicali latiuscula, frenis medium scutelli paullum superantibus. Sterna medio sulcata; orificia in rugam longiusculam oblique antrorsum producta. Hemelytra apicem abdominis paullum superantia, margine apicali corii levissime sinuato, membrana paucinervi. Abdomen hemelytris parum latius, subtus prope basin utrinque vitta stridulatoria curvata ad apicem segmenti tertii extensa instructum. Pedes mediocres, femoribus posticis intus spiculis stridulatoriis uniseriatis instructis, tibiis femoribus subæquilongis, supra sulcatis, tarsis triarticulatis.

Easily distinguished from *Oncocoris* by the structure of the head, the very small substylated eyes, and the short and broad body.

EURYNANNUS LIPPUS, sp. n.

Ochraceus, opacus, sat dense ferrugineo-punctatus (disco ventris tamen remotissime punctato), ubique maculis minutis nigris remotissime adspersus, macula parva nigra ad angulos basales et apicales segmentorum abdominalium notatus. Caput longitudine paullo latius, rostro apice nigro; antennis ochraceis, articulo tertio apice et duobus ultimis totis dilute ferrugineis, articulo secundo primo duplo longiore, tertio primo dimidio longiore, quarto secundo subæquilongo, quinto quarto æquilongo vel paullo longiore. Pronotum capite duplo latius. Scutellum mox pone medium levissime sinuatum. Membrana cinerea, maculis minutis nigris remote conspersa. Abdomen (♂) dorso apice arcuato-sinuatum, segmento ventrali sexto apice medio subrecto, latera versus levissime sinuato, medio segmento quinto duplo longiore, segmento genitali perpendiculari, ultra segmentum ultimum abdominale haud producto. Pedes maculis punctiformibus nigris remotissime conspersi, femoribus posticis apicem abdominis attingentibus, spiculis stridulatoriis ferrugineis.

Long. ♂ 5·6 *mm., lat.* 4·3 *mm.*

Queensland.

5. On the Anatomy of Limicoline Birds; with special Reference to the Correlation of Modifications. By P. Chalmers Mitchell, M.A., D.Sc. (Oxon.), Secretary to the Society.

[Received May 16, 1905.]

(Text-figures 23–28.)

In this memoir I use the term Limicolæ in the sense of Gadow (3) as a major subdivision of the Order Charadriiformes. I have dissected examples of the following forms, and where, in this paper, I refer to family-characters, I must be understood as limiting my remarks to the birds I have myself dissected, unless I definitely state otherwise:—

Suborder Limicolæ.

Family Charadriidæ	*Charadrius pluvialis.*
	Himantopus nigricollis.
	Vanellus vulgaris.
	Gallinago cœlestis.
	Rhynchæa capensis.
	Scolopax rusticola.
Chionidæ............	*Chionis alba.*
Glareolidæ	*Glareola pratincola.*
Thinocoridæ	*Thinocorus* species?
Œdicnemidæ	*Œdicnemus scolopax.*
Parridæ	*Hydrophasianus chirurgus.*

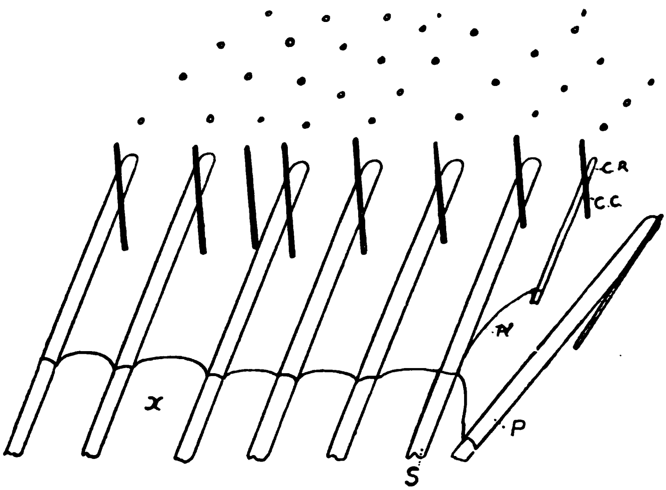
The greater part of the actual dissection was completed in 1902, in continuation of my work on Gruiform Birds (7); pressure of other duties has made it impossible to finish it sooner. I am indebted to the facilities afforded by this Society in the prosectorium at the Gardens for the material, and to my friend Mr. F. E. Beddard, F.R.S., the Society's Prosector, for much kindly interest.

Diastataxy in the Limicolæ.

In the arrangement of the feathers on the wing, all Limicoline birds are closely similar. They are diastataxic in the most typical form. The condition in *Chionis alba* (text-fig. 23, p. 156) may serve as an example. Along the edge of the ulna, from the wrist towards the elbow, the great quills with their associated coverts are arranged in an orderly series, but after four of these rows, each headed by a quill, there is a row from which the quill is missing, forming the diastataxic gap (text-fig. 23, *x*, p. 156). The carpal remex and covert are present (C.R., C.C.), the covert, in most cases (although not in *Chionis*), being conspicuously larger than the remex. These two feathers lie closer to the most proximal primary-

quill than to the most distal secondary-quill in most Limicolæ, but the position varies, and that shown in the diagram is more primitive. As evidence of their association with the secondary series, there is to be taken into account first the fact that the covert crosses the remex as in the secondary rows, not lying distal to it as in the primaries, and, secondly, that a plica (*pl.*), to which I have called attention in other groups (**4** and **5**), unites the carpal remex with the most distal secondary remex.

Text-fig. 23.



Wing-structure of *Chionis alba*.

Diagram of the distal secondary quills and coverts, showing the *diastataxic* arrangement.

S. First secondary. P. First primary. *x*. Diastataxic gap. C.R. Carpal remex. C.C. Carpal covert. Pl. Plica, binding carpal covert to first secondary.

The condition of the wing in the Limicolæ is similar to that found in the greater number of the Columbæ, but whereas in some Columbæ (**4**) the eutaxic condition is found—or, as I have tried to show, has been attained,—it has not been attained by any of the Limicolæ. In the Gruiformes, a somewhat incoherent group certainly closely related to the Charadriiformes, both conditions of the wing are present (**7**).

Gut-patterns in the Limicolæ.

I have already shown (**6**) that the pattern of the gut in Limicolæ is of considerable interest. It displays a configuration which differs from the pattern which is archecentric for all birds in a fashion similar to the divergence shown by the Gruiform birds,

and notably different from that of the Columbæ, or, indeed, of any other group except the Lari. The duodenal loop is simple and definite (text-figs. 24 and 25, A–B); the portion of Meckel's tract proximal to Meckel's diverticulum (Div.) tends to be enlarged in such a way that the diverticulum is not at the apex of a loop as in Columbæ or Passeres, but on the distal limb of a loop, which is short in the forms which are less specialised in this respect, such as the Chionidæ, Glareolidæ, Thinocoridæ, Œdicnemidæ, and the simpler Charadriidæ (such as *Numenius* and *Vanellus*),

Text-fig. 24.

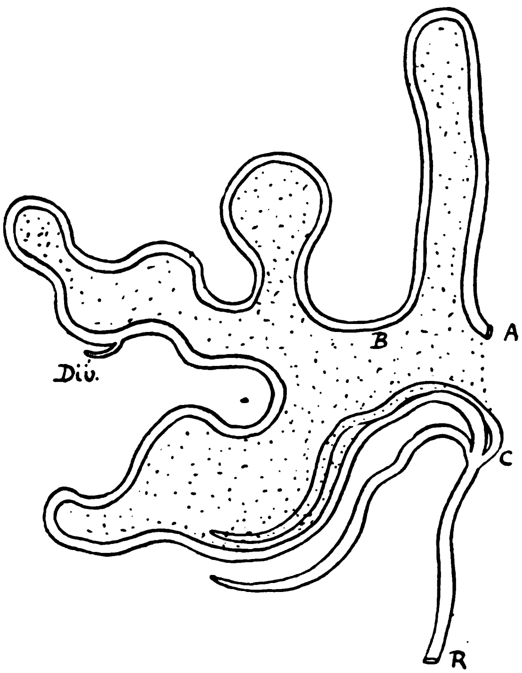


Diagram of intestinal pattern of *Rhynchæa capensis*.

A. Cut proximal end of duodenal loop. B. Distal end of duodenal loop. Div. Meckel's diverticulum. C. Origin of cæca. R. Cut end of rectum at cloaca.

but which in other Charadriidæ and Parridæ (such as *Scolopax*, *Himantopus*, and *Hydrophasianus*) is elongated and spirally twisted. The portion of Meckel's tract between this and the duodenal loop is ill-defined in the simpler forms, but in others tends to be thrown into a definite narrow loop. The portion posterior to the diverticulum is in close relation to the colic cæca, which are long in the simpler forms (text-fig. 24, C.), but become

almost atrophied in the more specialised types of gut-pattern—as, for instance, in *Hydrophasianus* (text-fig. 25, C.).

With regard to these two features of their structure, the conditions of which in Birds generally are pretty well known, the position of the Limicolæ is easy to define. In wing-structure they are diastataxic, like all but the most specialised Columbæ, and like many of the Gruiformes. In the gut-pattern they are not much modified from the archecentric condition, but the modification is definite, characteristic, and progressive, and, in its simpler form,

Text-fig. 25.

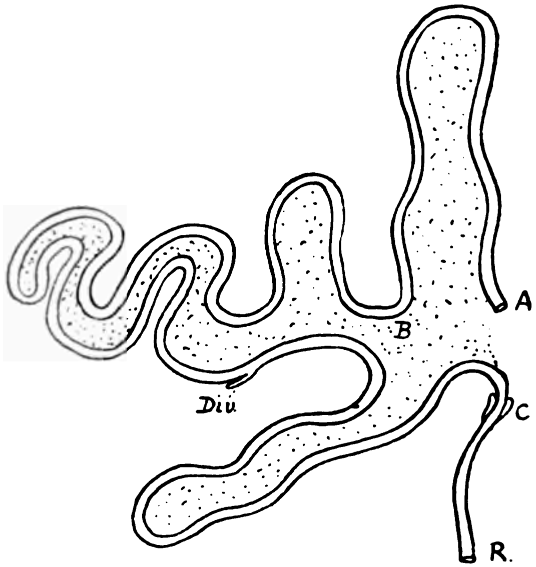


Diagram of intestinal pattern of *Hydrophasianus chirurgus*. Lettering as in text-fig. 24.

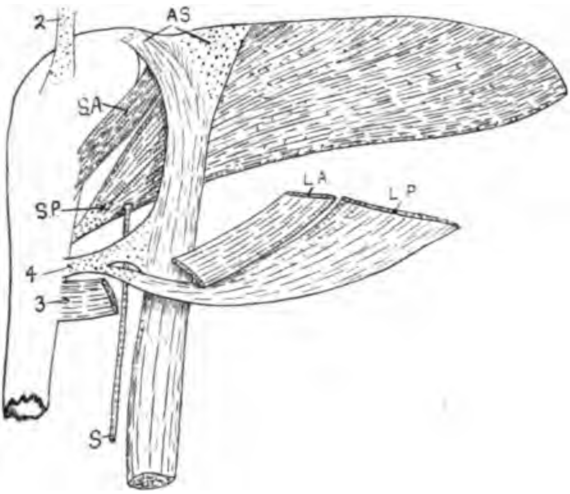
similar to that shown by the Gruiformes. In the more specialised types the elongation and spiral twisting of a portion of Meckel's diverticulum brings about a superficial resemblance with the arrangement in the long-gutted Columbæ and Passeres, but the morphological condition is different, as a different portion of the intestinal tract is affected. I shall now endeavour to set out the chief modifications in muscular anatomy that I have found to be of interest in these birds.

Muscular Anatomy.

Latissimus dorsi anterior et posterior.—The anterior division in all these birds is a broad flat muscular strap, without any peculiarities.

Its insertion is muscular, and just below that of the posterior division (text-fig. 26, L.A. and 3). The posterior division is absent in *Scolopax*, present in the others, and its proximal edge touches the distal edge of the anterior division in *Œdicnemus* (text-fig. 26, L.P. and 4) and *Hydrophasianus*, but not in the others. In *Hydrophasianus* and *Œdicnemus* the two muscles are almost continuous, although they cross before insertion, at which point they are closely in contact; whilst in the others the tendon of the posterior division is separated by a short gap from the muscular and more distal insertion to the humerus of the anterior division; this tendon is always in close association with the humeral anchor of the anconæus.

Text-fig. 26.



Shoulder-muscles of *Œdicnemus scolopax*.
Left shoulder; external view.

2. Tendon of supra-coracoideus. A.S. Anconæus scapularis, the reference lines pointing respectively to the humeral origin and the scapular anchor. S.A. Scapuli-humeralis anterior. S.P. Scapuli-humeralis posterior. S. Expansor secundariorum. L.A. Latissimus dorsi anterior. L.P. Latissimus dorsi posterior. 3. Insertion of lat. dors. ant. 4. Common insertion of lat. dors. post. and humeral anchor of ancon. scapularis.

The posterior division, where present, tends to spread backwards to reach the ilium and part of the ribs. In *Chionis* its origin is limited to the vertical anterior edge of the ilium, whilst the gap between it and the anterior muscle is wider than in any of the other birds.

The archecentric, or most generalised, condition of these muscles in Birds appears to be the existence of an anterior and posterior division, fairly well separated at their origins and close together

at their insertions. Any well-marked deviation from this condition may be regarded as derivative. I have shown that in the more specialised Columbidæ the posterior division of the muscle tends to disappear (**4**); in the Kingfishers the anterior division similarly is in progressive diminution (**5**); in most of the Gruiform birds the anterior division is less strongly marked, whilst the posterior division tends to increase greatly in size and strength, whilst in the Crane and Bustard it is the posterior division which disappears (**7**). In the Limicoline birds generally the anterior division remains in the primitive condition, whilst the posterior tends to enlarge as it does in the Rails, the enlargement being specially a backward and downward extension of the origin. On the other hand, in the Woodcock, as an exception, there is a disappearance of the posterior division.

Latissimus dorsi metapatagialis.—This muscle is probably present in all these birds, but it is very slightly developed and apt to be removed in the process of skinning.

Rhomboideus superficialis et profundus.—Of these two muscles, the superficial is phylogenetically older. In all these birds it is the thinner of the two muscles, but is longer, being longest in *Œdicnemus* and *Chionis*, whilst it shows a general tendency to die away posteriorly. In *Chionis* it is nearly divided into a proximal and distal portion by a thin central area, a secondary cleavage which is well marked in the deep muscle of the eutaxic Kingfishers.

The deep muscle in *Hydrophasianus* is almost of the same length as the superficial muscle and it is difficult to separate the two. In the others it is well separated by its greater thickness and by the slope of its fibres upwards and forwards from the scapula to the vertebræ. Its origin begins at the extreme posterior end of the scapula and extends forwards under the origin of the superficial muscle, but never reaching so far forwards.

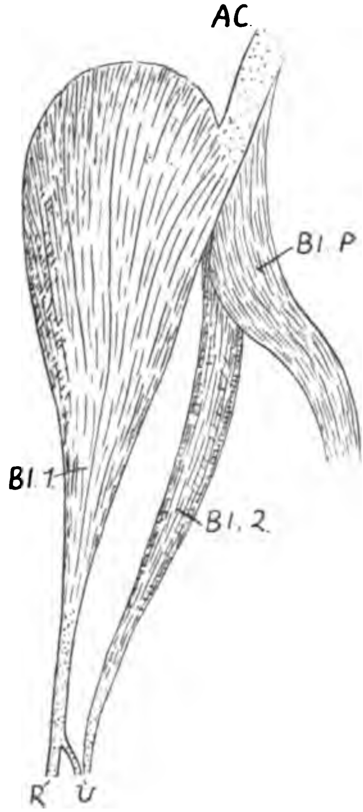
In the condition of these muscles, then, the Limicolæ are fairly homogeneous; the older superficial muscle is well developed, extending in front of the deep muscle, but, except in *Scolopax*, leaving a portion of it exposed behind. The deep muscle has made comparatively little progress in forward extension along the line of the scapula and clavicle.

Biceps brachialis.—This muscle displays in *Œdicnemus* the condition normal in the majority of birds; it arises by a narrow tendon from the acrocoracoid, and by a broad tendon from the proximal end of the humerus; the rounded belly runs down the arm and ends in a forked tendon, the thicker fork being inserted to the radius, the thinner to the ulna. No doubt, fleshy origins must have preceded tendinous origins, and there is considerable variation as to the relative size of the two origins and insertions in different birds; but the *Œdicnemus* condition is a fairly central one, and it is interesting to notice that in this respect *Œdicnemus* stands apart from other Limicoline birds and might be associated with many other groups. In *Hydrophasianus* there is a comparatively slight deviation from the normal, consisting in the complete disappearance

of the humeral head. This has already been noted by Fürbringer and Beddard (1 and 2), and the latter author states that he found a similar reduction in *Rhynchœa*. In the example of *Rhynchœa* that I dissected, however, I found a very different condition, the well-marked occurrence of a peculiar Limicoline deviation which occurs in a more or less modified form in all the other birds which form the subject of this paper.

The Limicoline peculiarity of the biceps brachialis is well marked in *Chionis* (see text-fig. 27). The main mass of the

Text-fig. 27.



Biceps of *Chionis alba*.

AC. Coracoid head. BI.P. Biceps patagialis. BI. 1. Chief portion of biceps. BI. 2. Accessory biceps. R. Radial insertion. U. Ulnar insertions.

muscle arises by a tendon from the acrocoracoid (AC.) and by a large and fleshy head from the humerus (BI. 1); this tapers towards the lower end of the humerus and then divides into a

large tendon inserted to the radius (R.) and a very small tendon to the ulna (U.). There is also a second belly, smaller and rounder, arising almost wholly from the coracoid tendon of origin (BI. 2), and towards the lower end of the humerus passing into a round tendon which is inserted to the ulna only (U.), distal to the insertion of the ulnar branch of the tendinous fork of Biceps 1. This doubled condition of the biceps is practically repeated in *Scolopax*, except that Bi. 1 appears to supply only the tendon to the radius, and the same state of affairs is present in *Gallinago*, *Charadrius*, *Himantopus*, *Vanellus*, and *Rhynchæa*. It occurs also in *Glareola* and in *Thinocorus*, but in the latter the humeral head is degenerate although present.

This complication of the biceps shows a link between the Charadriidæ, through *Chionis*, with a more exaggerated peculiarity in some of the Gulls. The condition in *Scolopax* differs from that in *Chionis* practically only in the tendon of Bi. 1 in the latter being forked so as to be inserted both to the radius and ulna. If we suppose this fork in *Chionis* to be split up into the body of the muscle so as to separate the portion of the belly arising from the acrocoracoid tendon from the portion coming from the humerus, the Gull condition would be reached. In *Larus*, for instance, the tendon of origin arising from the acrocoracoid divides into two fleshy bellies, the one representing Bi. 2 in text-fig. and running to the ulna, the other, fused with Bi. 1 in the figure, running independently to the radius. As there is very strong evidence of other kinds for supposing that the Gulls are modified from a Charadriiform stock, it would seem natural to suppose that here we have to deal with a case of progressive complexity, starting from the *Scolopax* condition and leading through *Chionis* to the Gull condition. But it is important to remember that, in cases of muscles and tendons of birds, the general morphological course is from the more complex to the simpler, and, to my mind, it is more probable that the *Scolopax* and general Limicoline condition is a simplification from the Gull condition, *Chionis* showing how the simplification may have come about.

Deltoidis patagialis.—This muscle is of moderate width in all these birds, and gives off the *longus* and *brevis* tendons from its relatively broad distal extremity, with not more than the slightest indication of division into peaks for the different tendons, and so far remaining in a primitive or archecentric condition. With regard to the tendons, *Œdicnemus* displays a condition markedly different from that found in all the others. The *longus* tendon is simple and slender; it has an anchor to the humerus, and, after being joined by the biceps slip, gives off one or two very weak slips of fascia to the patagium, and then takes the usual course towards the wrist. The *brevis* tendon is simple, flat, and well marked; it runs an undivided course towards the elbow, parallel with the biceps, and, close to its insertion, broadens out into a fan-shaped termination, which displays in a reduced condition the three slips named respectively α, β, γ by Fürbringer. In all the

other birds on my list the condition is much more complex, but as the complexity is similar in all, it is unnecessary to add to the figures given on plate xxi. of Fürbringer's great monograph (2). The *longus* tendon has an anchor to the humerus in all: it is broad and partly doubled in *Chionis*, *Scolopax*, *Vanellus*, and *Himantopus*; it is single in *Glareola*, *Thinocorus*, *Hydrophasianus*, *Charadrius*, *Rhynchæa*, and *Gallinago*, although in these a greater width in the elastic portion shows a tendency to duplication. In all, from just below the middle of its course, it sends a tendinous anchor inwards and downwards to join with the *a* portion of the *brevis* tendon; the width of this anchor and the exact point and mode of junction with the *brevis* tendon differ, but the details do not appear sufficiently important for individual description. The *brevis* tendon is doubled in all, the duplication being complete from origin to insertion. A well-defined tendon nearest to the biceps runs towards the elbow, where it is practically free from the second portion of the *brevis*; its extremity corresponds with γ of Fürbringer and it occasionally turns in towards the elbow, or may run a straight course towards the ulnar margin of the arm. The second division of the *brevis* is stronger and wider; it runs parallel with the latter, and nearer the *longus* tendon. At its distal extremity it divides into two well-marked slips—the proximal, being the β of Fürbringer and spreading out into a fan running towards the ulnar margin of the arm, whilst the more distal, the α of Fürbringer, receives the anchor from the *longus*.

Pectoralis propatagialis.—This slip is present in all the birds on my list. Leaving the pectoralis major it joins the deltoides patagialis before the muscular part of that muscle has given off the longus and brevis tendons, but its fibres run towards the longus rather than to the brevis. It is weakest in *Glareola* and *Thinocorus*.

Biceps patagialis.—This muscular slip, to the presence or absence of which Garrod attached so much importance, is present in all these birds and joins the longus. It is much weaker in *Glareola* and *Hydrophasianus*, where it is little more than a tendon. In *Œdicnemus* it sends a slip to the patagium, recalling the arrangement which I have described in *Heliornis* (7, text-fig. 78, p. 640). Its length varies, it being much longest in *Himantopus*, where its distal end nearly reaches the radial margin of the arm—an extremely specialised condition. Where the biceps is double, the origin of the biceps patagialis is sometimes from both portions (text-fig. 27, BI. P. p. 161), but in other cases it comes from the acrocoracoid head only, and in others again from the humeral head.

The condition of these alar muscles and tendons is of considerable interest. The first salient point is that *Œdicnemus* stands markedly apart from the others, showing in these structures, as in the biceps, an arrangement much more resembling that found in the Gruiformes, and, indeed, in many other birds, than the typical Limicoline condition. On the other hand, just as the complexity of the biceps in the Limicolæ recalls the similar

complexity in Gulls, so Gulls exhibit the doubling of the brevis tendon and the anchor from the longus to Fürbringer's *a*, which are the conspicuous features of the Limicoline alar complex. The general trend of change in the formation of the alar tendons seems to have been, first, the formation of distinct tendons from a series of scattered fasciæ and cutaneous slips, and next a reduction of the complex tendons to a more and more simple form. The most ready interpretation of the facts appears to me to be that in the ancestors of the Laridæ and Limicolæ a complex and specialised alar series of tendons had been elaborated; this condition has been retained by the Gulls and by most of the Limicolous birds, whereas in the Gruiformes and in *Œdicnemus* it has more or less completely disappeared, leaving traces such as the separation of the distal fan of the brevis into the small divisions which can be recognised as the α, β, γ of Fürbringer.

Deltoides major et minor.—In all these birds both muscles are present and display little divergence. The *minor* is extremely small in *Chionis*, *Gallinago*, and *Hydrophasianus*; in the others it is normal. The *major* is a muscle which in many birds displays a progressive tendency to creep down the humerus. It is shortest in *Hydrophasianus*, not reaching more than three-eighths of the proximal end of the humerus, and is without the usual scapular anchor. In *Gallinago* it reaches rather less than halfway down the humerus, in *Thinocorus* rather more; in the others nearly an exact half, the scapular anchor being well marked in all but *Hydrophasianus*.

Scapuli-humerales anterior et posterior (text-fig. 26, p. 159).—The posterior muscle (S.P.) is present in all these birds and is large and important, converging from an extensive origin occupying the greater part of the scapula to a rounded tendon inserted to the median process of the humerus. The anterior muscle (S.A.) is small and occupies the usual position across the angle between the scapula and the humerus. It is normal in *Œdicnemus* and *Hydrophasianus*, very small, merely a few fibres, in *Glareola* and *Thinocorus*. In *Charadrius* it is small but quite distinct, whilst in *Himantopus* it is represented by a narrow band of fibres. In *Chionis*, *Vanellus*, *Rhynchæa*, *Gallinago*, and *Scolopax* it is absent.

There seems little doubt but that the normal, or archecentric, condition in Birds is for both divisions of the muscle to be present, whilst the anterior division is frequently absent. The Limicolæ obviously form a group with a marked tendency to the disappearance of this muscle, but there is no special correlation between specialisation in other directions and the degree of reduction of the muscle.

Expansor secundariorum.—The specialised division of the anconæus to which Garrod gave the name of "expansor secundariorum" is a muscle in obvious course of disappearance in this group. It is present in a well-marked condition in *Œdicnemus* (text-fig. 26, S., p. 159) and *Hydrophasianus*. Its

proximal portion is well marked in *Scolopax*, *Himantopus*, *Gallinago*, *Rhynchæa*, *Vanellus*, *Charadrius*, *Thinocorus*, and *Glareola*, but it disappears before reaching the elbow. It is absent in *Chionis*.

Ilio-tibialis internus seu sartorius.—This muscle is practically identical in all the birds on my list. It arises from the anterior edge and a narrow portion of the anterior dorsal extremity of the ilium, and has the usual insertion to the fasciæ over the knee-capsule. In most cases, it shows little sign of fusion with the anterior edge of the ilio-tibialis.

Ilio-tibialis.—In all these birds this muscle is large, the post-acetabular portion having a strong fleshy origin, whereas the anterior portion is more membranous.

Ilio-trochanterici posterior, anterior et medius.—These muscles are all present in typical form in these birds, except that in *Thinocorus*, *Œdicnemus*, and *Hydrophasianus* the anterior and medius are nearly fused, showing only a trace of separation at their tendon of insertion to the femur.

Ilio-trochantericus externus.—This variable muscle is present in all these birds, but is extremely small in *Thinocorus*.

Ambiens.—This important muscle is present in all the birds on my list, and, in the normal fashion, ends in a tendon which passes through the capsule of the knee-joint and is reinforced (except in *Chionis*) by a ligament from the head of the fibula, finally forming one of the heads of origin of the muscle complex which gives rise to the perforated flexors of the second, third, and fourth digits.

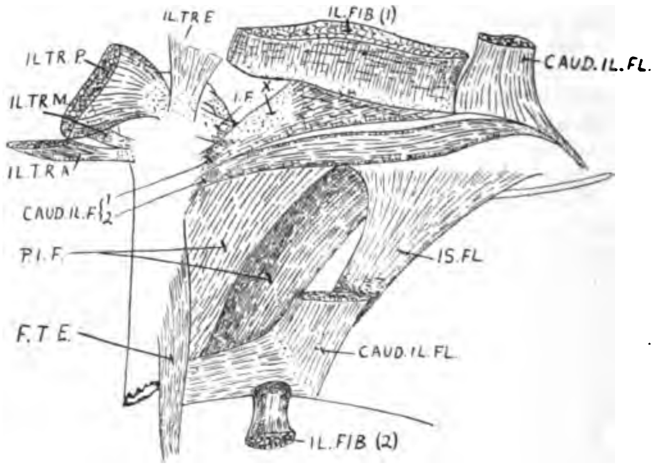
Femori-tibiales seu Cruræus and Vastus.—These muscles are alike in all the birds on my list, corresponding almost exactly with the condition I found in Gruiform birds (7), with the exception that in *Thinocorus* the femoro-tibialis externus is not developed as a separate slip.

Caud-ilio-femoralis (*Femoro-caudal and accessory F.-c.*) (text-fig. 28, p. 166).—The condition of these muscles, to which the researches of Garrod, Forbes, and Beddard have given special importance, differs in *Œdicnemus* from that found in the others. In *Œdicnemus*, as in *Otis* and many Gruiform birds, the portion with a caudal origin ("femoro-caudal" of Garrod) is totally absent; the portion arising from the ilium ("accessory femoro-caudal" of Garrod) is present and has the usual relations, but displays a considerable tendinous area in the middle of its muscular belly—an obvious sign of degeneration, to which I have already called attention (7).

The condition in *Chionis* (text-fig. 28, p. 166) is more generalised. Both muscles are present, the caudal portion (CAUD. IL. F. 2) displaying a fairly large rounded belly, which tapers to the tendon of origin which is inserted to the femur just distad of the insertion of the iliac portion. The iliac portion (CAUD. IL. F. 1) has a fan-shaped origin from the ilium, displaying on its proximal border a well-marked area of tendinous degeneration (X), and is

inserted to the femur along a narrow vertical line. In *Vanellus* the caudal portion is very large, whilst the accessory portion is present, but minute and with a tendinous degeneration similar to that just described. In *Thinocorus*, *Hydrophasianus*, and *Rhynchæa* both portions are present and large. In *Glareola*, *Charadrius*, and *Himantopus* the caudal portion is large, and the iliac is extremely minute, represented by not more than a few fibres. In *Gallinago* and *Scolopax* the caudal portion is of moderate size, the iliac portion completely absent.

Text-fig. 28.



Thigh-muscles of *Chionis alba*. Right thigh, external view.

IL.TR.E., P., M., A. Ilio-trochanterici externus, posterior, medius et anterior. IL.FIB. (1). Origin of ilio-fibularis seu biceps, cut and reflected. IL.FIB. (2). Insertion of biceps, cut and reflected. I.F. Ischio-femoralis, seu obdurator externus. CAUD.IL.F. 1, 2. Insertions of caud-ilio-femoralis (accessory femoro-caudal (1) and femoro-caudal (2)). CAUD.IL.FL. Caud-ilio-flexorius, cut, and origin reflected. IS.FL. Ischio-flexorius. P.I.F. Pub-ischio-femorales, seu adductores longus et magnus. The tendinous areas are dotted. X. Tendinous area on accessory femoro-caudal. F.T.E. Femoro-tibialis externus.

Œdicnemus in this respect, as in others, shows its wide divergence from the typical Limicoline condition. Of the others, *Thinocorus*, *Hydrophasianus*, and *Rhynchæa* show what is probably the archecentric or generalised condition for birds, the presence of both muscles in a well-marked form. The remaining birds of the list show that the tendency of modification in the group is for the disappearance of the iliac portion (the "accessory" of Garrod); and complete disappearance has been reached by *Gallinago* and *Scolopax*, two birds in other respects relatively highly specialised.

Caud-ilio-flexorius (*Semitendinosus and Accessory semitendinosus*), *Ischio-flexorius* (text-fig. 28).—In all these birds the three

muscles are present, and, save that in *Hydrophasianus* and *Himantopus* the semitendinosus and its accessory or femoral head were very small, the conditions I did not find to differ from the generalised state found in Gruiform birds.

Insertions of *Caud-ilio-flexorius*, *Ischio-flexorius*, and middle or posterior femoral head of *Gastrocnemius*.—In a former communication to this Society (7) I described the differences that exist amongst Gruiform birds in this respect, and I grouped these divergences round four central types. The conditions in the Limicolæ are more uniform, and may be explained by comparison with the figure of the *Otis* type (7, text-fig. 83, p. 651). In all the birds the internal adductor muscle (*Pub-ischio-femoralis internus*) sends a strong slip to the middle head (internal femoral) of the gastrocnemius, or may be actually fused with it. The internal femoral head of the gastrocnemius at its insertion to the femur is parallel with and distad of the accessory or femoral attachment of the caud-ilio-flexorius; in *Vanellus* and *Himantopus* the edges of the two are in close contact, although they are not actually fused as in the Rallidæ. In all the other birds on my list they are quite as in *Otis*. From the raphe between the accessory and main portion of the caud-ilio-flexorius a strong fibrous band runs downwards fusing with the middle head of the gastrocnemius, whilst another band from the same point of origin runs across to be inserted into the tibia, under the tibial portion of the gastrocnemius, generally in association with the similar insertion of the ischio-flexorius.

Gastrocnemius, external femoral head.—This is double in *Vanellus*, *Himantopus*, and *Charadrius*, single in all the others. The two heads unite before the muscle joins with the conjoined tibial and inner femoral portions. This recalls the similar doubling in *Cariama*, the three heads in *Otis* and *Eurypyga*, and the enormous undivided head in *Heliornis*. I have not information as to the occurrence of a similar variation of the external head of the gastrocnemius in other groups.

Ilio-fibularis (text-fig. 28, IL.FIB. (1) & (2)).—This muscle, with its sling and connections, exhibits practically identical conditions, and these not differing from the state in the Gruiformes generally in all the birds on my list. The fleshy origin is unusually large.

Pub-ischio-femorales (*adductors*).—These are both present in all the birds on the list. As I have mentioned above, the internal adductor has usually a strong connection with the middle head of the gastrocnemius. It is wider than the external adductor and shows traces of tendinous degeneration.

Tibialis anticus and Soleus.—These are present and normal in all the birds on the list, the tibialis anticus passing through a ligamentous ridge.

Extensor digitorum communis.—This has the normal arrangement and relations in all. Its tendon of insertion breaks up into two central slips for digit 3 and a single lateral slip at each

side for digits 2 and 4 respectively, except in *Glareola* and *Thinocorus*, where it is a fan-shaped slip of fasciæ common to the three digits, with the slightest trace of specialisation into tendons on the edges of the fan.

Peroneus superficialis (with slip to perforated tendon of digit 3), *Peroneus profundus*.—These muscles are present, with one exception, in the normal or archecentric condition in all the birds on the list. The exception is the peroneus profundus in *Œdicnemus*, in which bird it is practically absent, the absence being another point in which *Œdicnemus* differs from the Limicolæ and recalls many of the Gruiformes, such as *Otis*.

Flexores perforantes et perforati.—These muscles and tendons, including the slip connecting the tendon of digit 3 with the corresponding tendon of the perforated flexor, all present a practically identical condition, which does not differ in any important respect from the condition in the majority of the Gruiformes.

Flexores perforati.—These muscles in all the birds on my list have the usual inter-relations and divide into tendons for the three digits in customary fashion. The muscular mass has three heads: of these I have already described the ambiens head, which is similar throughout, except that there is no accessory ligament from the head of the fibula in *Chionis*. The external head is fleshy in *Himantopus*; it is small and tendinous in *Chionis*, *Glareola*, *Thinocorus*, *Hydrophasianus*, *Charadrius*, *Rhynchæa*, and *Gallinago*. It is absent in *Œdicnemus* and *Scolopax*.

Flexor profundus and Flexor longus hallucis.—In my communication on the Gruiform birds I described various ways in which the tendons of these two muscles (which are similar in their origin in all the birds on my list) are united with one another and distributed to the toes. I suggested that probably the most primitive condition was such as is to be found in *Eurypyga* (7, text-fig. 85, VII), where the longus hallucis sends a slip to the hallux, and distad of this blends so completely with the profundus tendon that each tendon supplies each of the three digits. The condition in *Chionis* resembles this closely, except that, as in *Rhinochetus*, the hallucis tendon, after giving off its slip to the toe, is not so markedly spread out for the other toes. *Œdicnemus* shows a state practically identical with that of *Otis*; there is no great toe, and therefore no slip to it; the spreading out of the junction of the hallucis tendon with the profundus tendon has become obliterated.

In *Hydrophasianus* the condition is exactly as in *Eurypyga*, except that, although there is a long great toe, there is no slip to it. In *Rhynchæa* the condition is also the primitive one, except that the slip to the great toe comes off a considerable distance above the branching of the conjoined main tendons for the three other digits. In *Scolopax* the condition is similar to that in *Rhynchæa*, but although there is a small great toe there is no slip to it, and the long junction of the two tendons is ossified.

Glareola and *Thinocorus* are like *Scolopax*, but have a slip to the great toe. *Vanellus* and *Gallinago* are exactly like *Scolopax*; *Charadrius* and *Himantopus* are also identical with it, except that there is no great toe.

The conditions of these tendons in Limicolæ are similar and much alike, being not far removed from the condition that I take to be archecentric or primitive for Birds. But in the group there is a tendency to lose or reduce the great toe, and that loss or reduction has produced modifications which are similar in character and very easy to derive from the primitive type.

Summary.

With the exception of *Œdicnemus*, the Limicoline birds examined, so far as relates to the characters dealt with, show a definite and coherent series of modifications. The group is moving, or has moved, along the same anatomical lines. The limits of its variations overlap in a special way the variations displayed by Gulls, and in a general way those exhibited by Gruiform birds.

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6. Observations upon a Female Specimen of the Hainan Gibbon (*Hylobates hainanus*), now living in the Society's Gardens. By R. I. Pocock, F.L.S., F.Z.S., Superintendent of the Gardens.

[Received May 16, 1905.]

(Plate V.*)

Age at Maturity.

On Jan. 26, 1904, the Society received on deposit a female specimen of the Hainan Gibbon, the property of Mr. E. H. de

* For explanation of the Plate, see p. 180.

St. Croix, who procured her in the island of Hainan on July 11th, 1897. She had thus been in captivity nearly six years and seven months. On the testimony of natives, her owner believed her to be about six weeks old at the time of capture; but since, as he affirms, she was already weaned and capable of fending for herself in the matter of food, it is probable that she was very much older than was supposed. On the assumption that she was at least six months old, it may be inferred that the beginning of 1897 was the approximate date of her birth.

Menstruation set in at the end of the first week of December 1903; and taking this as the sign of maturity, coupled with the fact that she has not increased appreciably in size since her arrival in the Gardens, it may be assumed that she became adult when about seven years old. And in view of the close affinity between the various species of Gibbons and the subequality in size of full-grown individuals, it may be further inferred that about seven years are required on an average for these animals to reach maturity *.

Menstruation.

Very little appears to be known about the menstruation of Gibbons. In Chimpanzees, according to Dr. Keith (P. Z. S. 1899, p. 297), the discharge is sanguineous in colour, profuse, monthly in occurrence, and three days in duration. In our Hainan Gibbon it is also sanguineous, stains the floor of the cage, and, according to her keeper, Mansbridge, who also looked after the Society's historic Chimpanzee "Sally," is about the same in quantity relatively to the size of the animals as in that ape. The pudendal organs are always conspicuous by reason of their turgescence, and no very conspicuous change in their condition precedes the menstrual discharge. In this particular the Gibbon differs markedly from certain Cercopithecidæ (such as Baboons, Macaques, and Mangabeys), and also, to judge from published and verbal accounts, considerably, though to a lesser degree, from Chimpanzees. With the help of Mansbridge and Robertson, the two keepers of our Anthropoid Apes, I recorded the dates of the appearance of the discharge during the autumn, winter, and spring. The first noted was from Sept. 12 to 14, the second from Oct. 14 to 16, and the third from Nov. 19 to 21. During December the animal had a severe illness, beginning with an influenza cold and ending with diarrhœa, which was accompanied by extreme wasting and weakness. This illness extended over the time for menstruation, which did not appear in December. In January also there was no sign of it observable, although by the middle of that month she had apparently recovered her normal health. It is probable, I think, that the cessation for these two midwinter months was due to the illness. But it is by no means impossible that cessation during that time of the year is normal. The question can only be

* Perhaps the Siamang (*Symphalangus*), which exceeds the other Gibbons in dimensions and differs from them in other respects, will be found to be an exception.

decided by observing what happens in the ensuing winter, should the animal still be in the Gardens. Menstruation reappeared on Feb. 6 to 8, and has continued at tolerably regular monthly intervals since. Hence it may, I think, be laid down as an established fact that in Gibbons the interval between the menstrual discharges is a little over the calendar month and that the discharge continues for from two to three days.

Determination of the Sex.

When Mr. de St. Croix brought the specimen to the Gardens he informed me that she was a castrated male; and in support of his opinion drew my attention to the large size of the clitoris, which he most naturally mistook for the penis. The naked and turgid labia of the vulva he regarded as the unhealed wound caused by castration; and the menstrual discharge which first appeared in December of 1903, when the Ape was on her way to England, he attributed to normal bleeding induced by enforced sitting on the hard floor of her travelling-box. He also told me that it is commonly believed in Hainan that female specimens of the Gibbon are never brought to the coast and are practically unobtainable.

There can be no doubt that this belief, coupled with the peniform clitoris of the Gibbon, misled Mr. de St. Croix as to the true sex of his animal, the castration of which, he admitted, he had not himself witnessed. And it seems probable that the belief itself is traceable to repeated mistakes on the part of Europeans in determining females as castrated males on account of the unusual length of the clitoris in these Apes as compared with the same organ in the Monkeys of the Old World generally. In this connection it is interesting to recall the fact that Dr. Harlan *, after dissection of the generative organs, described his specimen of *Hylobates concolor* as "an hermaphrodite Orang Outan." It appears to me, however, that Lesson's criticism of this opinion was perfectly justifiable and his decision that the specimen was an immature female undoubtedly correct. Pousargues, also, who evidently did not know Lesson's paper, came independently to the same conclusion, and stated that in the type of *Hylobates nasutus*, a young female, the clitoris was well developed and grooved below; and that the animal resembled in every particular, so far as the generative organs were concerned, the Gibbon determined as an hermaphrodite by Harlan. And since Harlan and two other doctors, presumably acquainted with human anatomy, who assisted at the dissection, were deceived as to the true sex of the specimen, in spite of the best possible opportunities for investigation, it is no wonder that the Europeans living in Hainan fall into a similar mistake.

So far as can be seen, the clitoris of our Hainan Gibbon is like that of the specimen figured and described by Harlan, which resembled the penis of a Primate in a state of hypospadias. A

* For Bibliography, see *infra* pp. 174–175.

comparatively slight structural modification would convert such an organ into a closed tube for the passage of the urine—a fact perhaps of some significance in connection with the low position of the Gibbons in the Anthropomorphous series, seeing that in the Lemurs, the lowest of existing Primates, the clitoris is traversed by the urethral canal.

Change of Colour.

I am informed by Mr. de St. Croix that the young of both sexes of this species are alleged by the natives to be lighter-coloured at birth and for a short time afterwards than their parents. His animal, when first purchased, was a dark smoky grey, which, however, soon turned to black; and perfectly black she remained all the years she was in his possession. But within a few weeks of being brought to the Gardens she began to go grey, Mr. de St. Croix himself noticing a decided alteration in this respect when he visited her on March 8th, about six weeks after her arrival in London. During the spring and early summer the greyness progressed rapidly, but not quite uniformly all over the body. In midsummer, according to my notes, the head was black with a grey band extending on each side from the eyebrow over the ear; the beard was whitish and the nape of the neck blackish; the greater part of the body was blackish grey, with a considerable quantity of blacker hair on the sides of the belly close to the thigh and a broad triangular black patch, narrower posteriorly, extending from the collar-bones on to the fore part of the belly and bordered on each side by a grey area paler in tone than the back; the thigh and upper arm were paler than the distal portion of the limbs. By this time she was not recognisable as the animal that reached the Gardens in January. Still the greyness continued to spread, the black pigment died out from the areas mentioned above, lasting longest upon the chest and the crown of the head. At this period she presented a decided similarity to the left-hand figure on the plate depicting *H. pileatus* Gray (P. Z. S. 1861, p. 136, pl. xxi.), although the black pectoral area was smaller and the patch on the crown less sharply defined at the edges. In the early autumn she was a stone or silvery grey practically all over except for a black median band, fading away laterally and posteriorly, down the middle line of the head.

At the present time (May 1905) she is brownish grey or silvery grey in colour, the tint varying according to the light. The black cap is still retained as a patch broadest and blackest between the ears, fading into brown upon the forehead and narrowing towards the nape of the neck. The hair on the chest has grown pale and thin, showing the blackish-grey tint of the underlying skin as a dark triangular shield. On the penultimate phalanges of the hands and feet the blackness of the hairs persists. The long hairs on the brows are also black.

It is known that in some species of Gibbons, e. g. *H. leuciscus*, according to Mr. Hose, the individual variation in colour is considerable, like unto that which obtains indeed in some Squirrels and Lemurs. But, so far as I am aware, it was not previously known that a given individual after reaching maturity may change in colour in the way exemplified by Mr. de St. Croix's specimen. This change may be compared to that which takes place in the hair of the human head concomitantly as a rule with senescence or to that exhibited by some specimens of the Arctic Fox upon the approach of winter*. It is not accompanied by any replacement of coat, nor is it directly attributable to any change in the environment or to external agencies. The cause, whatever it may be, lies within the organism itself; it is constitutional or subjective, and as such may be distinguished by the term "canescence," from the decoloration or fading which is caused by exposure to sunlight or other bleaching agencies.

In the case of the Hainan Gibbon it is important to note the coincidence between the appearance of menstruation and that of the colour-change. The former phenomenon began in December 1903, the latter about February 1904.

Of the two specimens of this species in the British Museum (both of which are jet-black), one is only about two-thirds grown; the other, the type, as Mr. Oldfield Thomas states, not quite adult; and since Mr. de St. Croix's specimen is, on the contrary, full-grown, it might be inferred that it is characteristic of the species to change from black to grey upon reaching maturity. This, however, is not the case; for Mr. de St. Croix informs me that he was acquainted in the island of Hainan with another specimen, alleged to be a male, which was jet-black, like his own before coming to the Zoological Gardens, and had been in captivity sufficiently long to justify the belief that it was about twelve years old when he last saw it.

Is the canescence, then, a matter of sex and exhibited only by mature females? The balance of evidence seems to be on the whole in favour of an affirmative reply to this question. For, apart from the change here recorded of the only adult female known, it must be remembered that Mr. Swinhoe, in his published account of all the information respecting the Hainan Gibbon he was able to gather, quotes from the Chinese gazetteer of the Kiung Shan district of the island a passage stating that the male is black and the female white (P. Z. S. 1870, p. 244, &c.).

* There are two Arctic Foxes living in the Zoological Gardens at the present time. One remains dark-coated throughout the year; the other turns snow-white towards the winter. In both the winter coat, whether "white" or "blue," is replaced in the summer by a darkish brown clothing of new hair, which is at its best in August, but becomes paler and loses to a large extent its richness of tint as it grows. In neither is there an autumn moult comparable in extent to that of the spring; and there is no doubt that in the animal which turns white the metamorphosis is effected by the destruction of the pigment in the hairs themselves. This bears out Major Barrett-Hamilton's statement as to what occurs in the Arctic Hare.

The Name of the Species.

The correct name for this species is still unsettled. The specimen now living in the Gardens is specifically identical with the type of *H. hainanus* Thos., and with the specimen previously exhibited in the Menagerie * and now in the British Museum, with both of which I have compared it. According to Matschie †, however, *hainanus* is a synonym of *concolor* Harlan ‡. This opinion was based apparently upon the similarity in colour between the types of *concolor* and *hainanus*; but it unfortunately involves the assumption that the locality given for *concolor*, namely Borneo, is erroneous. It is also objectionable on the grounds that the hair of *concolor* was described as "thick, woolly, and frizzled." The last two epithets are in no sense applicable to the hair of either of the three specimens of *hainanus*, comprising young and adult animals, available for examination. In these the hair, although thick, is smooth, depressed, relatively coarse, and quite unlike the hair of a young specimen of *H. lar* from Pahang, now in the Gardens, which is essentially rough and woolly; and also equally unlike that of examples of *H. agilis* in the British Museum, which is beautifully silky and woolly. Furthermore, Trouessart § adopts for the species the name *harlani*, unlawfully proposed by Lesson ‖ as a substitute for *concolor* Harl., alleging that *concolor* was first applied by Harlan in 1825 to a young specimen of *H.* (*Symphalangus*) *syndactylus*. *Concolor*, therefore, falls as a synonym of *syndactylus*, and *harlani* comes in for the species described by Harlan in 1827, which Trouessart follows Matschie in identifying with *hainanus*. Trouessart, however, gives no reference to Harlan's paper of 1825, and since I have failed to find it in the Royal Society's Catalogue, and there is no suggestion in Harlan's paper of 1827 (contained in a volume dated 1825), or in Lesson's almost contemporaneous criticism of it, that the name *concolor* had been previously published, I must conclude that Trouessart has fallen into some error. But in any case, since the specimen described by Harlan in 1827 as *concolor* and renamed *harlani* by Lesson in the same year and erroneously quoted as *niger* by Ogilby (P. Z. S. 1840, p. 20) was definitely stated to have come from Borneo and to have had thick woolly frizzled hair, and since it is only known to have resembled the type of *hainanus* in the matter of coloration, an admittedly variable feature in the genus and one in which it also resembles *H. syndactylus* ¶, it is, in my opinion, premature to state without qualification that *hainanus* is a synonym of *concolor*.

* Sclater, P. Z. S. 1892, p. 541.
† SB. Ges. nat. Freunde Berlin, 1893, p. 211.
‡ Jr. Acad. Sci. Philad. v. pt. 2, p. 231 (1827).
§ Cat. Mamm. Suppl. 1904, p. 6.
‖ Bull. Sci. Nat. xiii. p. 111 (1827).
¶ Since Harlan states (*loc. cit.* p. 231) that *concolor* differs from *H. syndactylus* and other species in being of a universal black colour, it is assumable that he did not know *H. syndactylus*. I do not, however, suggest that *concolor* is a synonym of *syndactylus*, because Harlan states that his specimen had no guttural sacs.

Again, Pousargues * believed *hainanus* to be established upon a specimen of the same species as the type of *H. nasutus*, from Tonkin. This belief was also based upon resemblance in colour. Nothing else is known of the characters of *nasutus* except the alleged presence of a "fine and delicate little nose," whence the name was derived. But since *hainanus* is not distinguishable from other Gibbons by the fineness and delicacy of its nose, judgment on the synonymy suggested by Pousargues must be suspended until the type of *nasutus* has been re-examined and described. Trouessart, who may have seen the type, gives *nasutus* the rank of a subspecies of the Hainan form.

No further justification need, I think, be sought for retaining the name *hainanus* for the subject-matter of these remarks.

Description of the Species.

Face, ears, palms of hands, soles of feet, and skin black, the face with a slightly brownish tinge; iris and exposed portion of eyeball blackish. Colour of hair either uniformly black, with shining tips, or grey, the roots of the hair being tinged with fawn or washed-out brown, their exposed portion shining with silver-grey lustre in reflected light, but of a more stone-grey in direct light. During the change from black to grey, the coloration is a mixture of the two, the black or the grey predominating according to the nearness of the time of observation to the incipience or completion of the change.

On the crown of the head a median longitudinal black patch with ill-defined edges and extending posteriorly as a narrow evanescent stripe persists. A few scanty hairs upon the penultimate phalanx of the fingers and toes and the long hair on the brow also remain black. The hair on the body and limbs is longish, soft, and thick, but depressed and smooth. It is not woolly in the sense that the hair of our young Lar Gibbon is woolly, *i. e.* much resembling a Sheep's fleece; nor does it exhibit the fine and silky woolliness of the skin of *H. agilis* in the British Museum. On the forehead and crown of the head the hair is shorter, fine, and close, and in the living specimen grows somewhat *à la Pompadour*, being erect on the crown and almost porrect on the forehead, so that the head has the appearance of being very much higher than in our living example of the Hoolock (*H. hoolock*) and in adult skins of *H. lar*, *H. pileatus*, and *H. leuciscus* in the British Museum, in which the hair lies smoothly backwards. The difference may be briefly expressed by saying that in our Hainan Gibbon the hair looks as if it had been brushed up, whereas in the others it looks as if it had been

* Bull. Mus. Paris, 1900, p. 272. Pousargues gave A. Milne-Edwards the credit of naming *nasutus*. Milne-Edwards, however, published no description of the species when the name was quoted (Le Naturaliste, 1884, p. 407). Hence it seems that Kunckel d'Herculais, who first associated the name with definite characters, must be regarded as the author (Science et Nat. ii. no. 33, p. 86, 1884).

brushed down. In the two skins of *H. hainanus* in the British Museum, however, the hair on the crown is not so markedly upstanding, nor so long, as in the living example. On the cheeks the direction of the hairs is, generally speaking, upwards. On the upper surface or back of the hand and on the corresponding surface of the forearm the points of the hairs lie towards the ulnar side of the limb, assuming a more and more elbowward direction as that joint is approached. On the palmar and radial side of the forearm, on the contrary, the hairs point for the most part towards the wrist. The palmar surface, however, is marked by a crest formed by the meeting of the two opposing streams of hair, the crest extending obliquely from the radial side of the elbow to the ulnar side of the wrist, the hairs on the ulnar side of it being directed proximally, those on the radial side distally. On the body the hairs lie backwards, except on the belly, where they incline towards the middle line and form a median longitudinal crest where the two streams meet. This is the area against which the inner sides of the thighs are pressed when the Gibbon is in a sitting posture. On the outer side of the thigh the direction of the hair is upwards (proximad) and backwards, below the knee it is downwards (distad).

Additional Notes.

The voice of our Hainan Gibbon is quite different from that of the Hoolock. It is a high-pitched trill all on the same note, and shriller even than the high note of the Hoolock's cry. It consists of from about three to six distinct cries repeated in very rapid succession, suggesting almost production by vibration of the tongue, although, as a matter of fact, I believe the lips alone are instrumental in producing the effect. There is then a momentary pause, after which the cry is repeated. It may perhaps be represented in the following way:—ho͝o ho͝o ho͝o ho͝o—ho͝o ho͝o ho͝o—ho͝o ho͝o ho͝o ho͝o ho͝o—&c. The Hoolock, on the contrary, cries as follows:—hāh, ho͝o, hāh, ho͝o, hāh, hāh, ho͝o, hāh. The "ho͝o" is on a lower note than the "hāh," with which the cry frequently ends.

The ordinary expression of anger or remonstrance in the Hainan Gibbon is a prolonged and guttural grunt, which is repeated rapidly and often, and frequently interspersed with a kind of warble when the excitement rises.

Both the Hoolock and the Lar Gibbon in the Gardens drink habitually by dipping the back of the hand and knuckles into the dish and licking the water off. They do not scoop it up, in the strict sense of the word, at all. Hence Col. Tickell's generalisation to the effect that in its habit of scooping up water in its hands the Lar Gibbon differs from the Hoolock, which applies its lips directly to the fluid, is contradicted on both counts by our specimens of these species. The Hainan Gibbon, on the contrary, almost invariably drinks direct with her mouth, only very rarely using her left hand for the purpose. It is possible she may have

abandoned the habit of employing the hand at the time when an injury deprived her of the use of her right arm. And since the left is frequently occupied in supporting herself upon the bars or perches in the cage, she has no hand available for the purpose of drinking without quitting her hold.

This method of hand-drinking, probably common to all Gibbons, may have arisen in connection with their arboreal life. To avoid descending to the ground, they would naturally lick the rain-drops off the leaves near by, and their great stretch of arm would enable them to wipe the water off foliage hanging beyond reach of the mouth, the hairy back of the hand being clearly more fitted for the purpose than the smooth palm. In connection with this habit, it is interesting to recall the story told by Duvaucel of female Gibbons carrying their young to the waterside and washing their faces with their hands. This alleged proceeding, presumably witnessed in the jungle, can hardly, I think, be accepted without confirmation, on account of the absence of any obvious reason for the ablutions. If the young Gibbons of which the tale is told were hanging, as is their wont, to the breasts of the mothers, the action of hand-drinking by the latter might very easily be mistaken at a distance for the face-washing.

Amongst "quadrumanous" Primates the Gibbons have no equals in proficiency in the use of the arms for arboreal and the legs for terrestrial progression. Moreover, within the limits of the entire order, they are only surpassed in bipedal activity by the specialised biped Man.

Although able to stand and walk to a very limited extent, Monkeys are essentially quadrupedal and employ their arms and legs to an approximately equal extent in traversing the level ground, scaling rocks, or climbing trees. Generally speaking, the most active climbers are long non-prehensile tailed species, such as the Mangabeys *, in which the tail acts as a balancer, like the pole of a tight-rope dancer. Monkeys of this kind leap with great precision and strength, and pass with speed from branch to branch in virtue of the great propelling power in their hind-quarters. They are specialised for that manner of progression, which only differs in degree of perfection from that of other Monkeys and Lemurs as a whole. The method, however, is entirely distinct from that practised by the Gibbons, which swing from branch to branch, with the legs tucked up out of harm's way against the body, the motor power lying exclusively in the arms. Both groups have been specialised for arboreal progression, but along totally different lines; and it is as difficult to believe that the Gibbons, expert gymnasts though they be, have been derived from active long-tailed climbers, like the Mangabeys or Langurs for instance, as it is to believe that the tail-swimming Cetaceans have been derived from forms like the flipper-swimming Seals.

* I have never yet seen the Baboon or Macaque that could catch a Mangabey single-handed, given equal conditions as to health and age, in a large-sized cage.

This conclusion respecting the descent of the Gibbons may be inferred from their habits alone, quite apart from structure.

If the Anthropoid Apes be ranged in series according to proficiency in bipedal locomotion, the order will be (1) Gibbons, (2) Gorillas, (3) Chimpanzees, (4) Orangs. Gibbons not only stand erect and habitually walk without putting the hands to the ground; they can even run with astonishing speed, a speed indeed comparable to that of Man, allowance being made for difference in size. Like Man they race away when scared; and, unlike the other Anthropoid Apes, they do not use their arms as crutches. Sometimes also, but rarely, they leap over the ground with both feet together *.

Gorillas can stand and walk upright, but not with the ease of Gibbons, and it may be doubted if they ever run erect or leap, *i. e.* progress with both feet off the ground at one time; and they probably never run from danger, standing upright, as Man and Gibbons do. Their usual walk is quadrupedal.

Chimpanzees, too, are essentially quadrupedal; and under ordinary conditions, and when in perfect health, almost always get over the ground on "all fours," like a Baboon or Rhesus. In this respect, indeed, they more resemble the Cercopithecoid Monkeys than does any other Anthropoid Ape; and they are able to cover the ground with much greater speed than either Gorillas or Orang-Utans; but I am unable to say if their quadrupedal method is so fast as the bipedal method of Gibbons. Like Baboons, they can stand erect and walk to a certain extent, but not with the facility of Gorillas.

The gait of young Orang-Utans may be described as a clumsy quadrupedal shuffle. I never saw one stand unsupported by the arms. Weakness of leg and weight of body make exclusively bipedal action, if not an impossibility, at least so great an effort that it may be doubted if it is ever resorted to. Their whole organisation suggests unfitness for terrestrial locomotion.

Thus, if the Apes be classified according to their quadrupedal activity on the ground, they will stand:—(1) Chimpanzees, (2) Gorillas, (3) Orangs, (4) Gibbons.

It is interesting to compare this series with one based upon dexterity in climbing and addiction to arboreal life. It is: (1) Gibbons, (2) Orangs, (3) Chimpanzees, (4) Gorillas. The Gibbons stand quite alone both in method and expertness; the others differ *inter se* merely in degree.

The foregoing results may be briefly summarised as follows:— The Gibbons are the most expert climbers and bipedal walkers, the least expert quadrupedal walkers. The Orangs rank second in climbing, third in quadrupedal and fourth and last in bipedal activity. The Gorillas take fourth place in climbing, second in bipedal and second in quadrupedal activity. The Chimpanzees

* These and the following statements and reflections are based upon my own observations of the Anthropoid Apes that have come under my notice in the Society's Gardens.

stand third in climbing, third in bipedal and first in quadrupedal powers.

Since, therefore, the action of Monkeys, whether Cercopithecidæ, Cebidæ, or Hapalidæ, and of Lemurs is essentially quadrupedal, the fore and hind limbs being used to an approximately equal extent, both in terrestrial and arboreal locomotion, it may be inferred that the Chimpanzees have departed least in these respects from the primitive Primate stock; the Gorillas a little more in the line of bipedal erection and, concomitantly, loss of climbing power; the Orangs still more in the direction of loss of terrestrial activity and increase of arboreal expertness; the Gibbons most of all in the line of bipedal activity, dexterity in hand-climbing, and loss of quadrupedal power.

This serial arrangement of the Apes is the exact opposite of the one prevalent in text-books, where the order adopted is based upon structure with Man placed first as the standard for comparison. It suggests that for the origin of Gibbons we must look not to forms resembling any known Cercopithecoid type, but to forms which had already acquired the Simiine or Anthropomorphine characteristics and had either lost or never learnt the method and skill in climbing found in the former group. They may have started from a type somewhat on a level with the Chimpanzees with respect to terrestrial and arboreal activity; and to swing with greater facility from tree to tree and to obviate the risk of injury in case of a fall, it is highly probable that they have become dwarfed in stature and grown lighter in build. Their muscularity and length of arm, slightness of body and strength of leg, all factors of importance in enabling them to traverse the jungle and, in case of a miss or a breaking branch, to drop lightly to the ground and run to the nearest tree for safety, were probably perfected concomitantly. That Gibbons are able to drop with safety a considerable distance is substantiated by the fact that Mr. de St. Croix has seen his specimen come to the ground without injury from a height of about 20 feet. When leaping to the ground Gibbons swiftly draw up the knees as the feet touch, exactly as a man does under similar circumstances, to break the shock.

Another interesting feature connected with the habits of the Anthropoid Apes is the size of their ears. I have already suggested that the difference in size between the ears of the Orang and those of the Chimpanzee may be connected with the difference of habits of the two animals. The Orang lives a more arboreal and therefore a safer life than the Chimpanzee, which requires quick hearing to enable it to escape to the trees when feeding on the ground *. Gibbons also, which have relatively large ears, need auditory acuteness for the same purpose as Chimpanzees. This explanation, however, is not complete and appears at first sight to be contradicted by the case of the Gorillas, which have small ears

* 'Nature,' Oct. 11th, p. 585 (1900).

and yet are less arboreal in habit than other Anthropoids. It must be remembered, however, that they are far more capable of self-defence and much less liable to attack and therefore need less keenness of ear as an aid in avoiding enemies. In this connection it is important to note that of the two Apes inhabiting W. Africa, namely the Chimpanzee and the Gorilla, and of the two inhabiting the East Indies, namely, the Orang and the Gibbon, the larger and stronger has in each case small insignificant ears and the smaller and weaker large ears.

EXPLANATION OF PLATE V.

Hainan Gibbon (*Hylobates hainanus*), from the female specimen now living in the Society's Menagerie. The lower figure, taken from an obscure photograph by Mr. W. P. Dando, F.Z.S, represents the Ape when she first came to the Gardens. The upper figure, modified from a photograph of another Gibbon, shows her as she has been since the change of colour took place.

June 6, 1905.

Dr. Henry Woodward, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in May 1905 :—

The registered additions to the Society's Menagerie during the month of May were 367 in number. Of these 174 were acquired by presentation and 27 by purchase, 129 were received on deposit, 25 by exchange, and 12 were born in the Gardens. The total number of departures during the same period, by death and removals, was 185.

Amongst the additions special attention may be directed to :—

A Crowned Duiker (*Cephalophus coronatus*) from West Africa : deposited on May 1st.

A Maxwell's Duiker (*Cephalophus maxwelli*) from W. Africa : presented by Lieut.-Col. Bartlett, R.A.M.C., on May 16th.

A Nepalese Hornbill (*Aceros nepalensis*) from the Himalayas : received in exchange on May 18th.

Two Sulphur-breasted Toucans (*Rhamphastos carinatus*) : purchased on May 13th and May 23rd respectively.

Mr. Oldfield Thomas, F.R.S., exhibited a specimen of a Bushbuck which had been obtained by Mr. C. W. Haywood in British East Africa and which appeared to represent a new species of the group. It was described as follows :—

TRAGELAPHUS HAYWOODI Thos.*

Thos. Abstr. P. Z. S. No. 21, p. 9, June 13, 1905.

A large heavily-built member of the group of small species without a definite short-haired collar. Under surface darker than upper.

Fur comparatively coarse and long throughout, the hairs of the back 35–40 mm. in length. General colour very dark, the nape black; the fore-quarters blackish brown (near "seal-brown"), passing into dark reddish brown ("vandyke-brown") on the middle back and deeper rufous (dark "tawny") on the rump. Sides gradually darkening downwards to the wholly black belly. Dorsal crest black as far as the withers, then whitish mixed with some black hairs. Three inconspicuous transverse whitish stripes on each side. No longitudinal bands, but a few white spots on the sides of the rump. Shoulders and proximal part of limbs deep black, succeeded by tawny below. (Feet unfortunately lost in the type.) Top of muzzle nearly black, with prominent interorbital whitish streaks nearly touching each other in the middle line. Forehead and crown deep ferruginous. Cheeks tawny ochraceous. Two white spots on each side behind and below the eyes. Ears thinly haired, dull tawny brown with blackish edges; hairs of inner surface white. Chin and interramia white and a large throat-spot duller white; between this and the white chest-band the throat was glossy blackish, mixed with some tawny hairs. White axillary and inguinal patches present. Tail dark tawny, white below.

Skull very large and heavy for one of the smaller members of the genus, much larger than in *T. scriptus* or *sylvaticus*. Median palatal notch rather farther forward than the lateral ones. Palatal foramina comparatively long.

Horns also very powerful, thick and strongly ridged, much finer than those of any of the allied forms.

Skull dimensions of type:—

Greatest length 265 mm.; basal length 247; greatest breadth 112; muzzle to orbit 134; muzzle to front of p^2 77; length of palatal foramina 36. Length of upper tooth-series 72, of three upper premolars 31.

Horns: length in straight line 400; on anterior ridge 470; greatest basal diameter 59; basal circumference 171.

Hab. Nyeri, Kenya District, British East Africa. Altitude 6000 feet.

Type. Full-grown male. B.M. No. 5.5.16.3. Collected and presented by C. W. Haywood, Esq.

Mr. Oscar Neumann † had sorted the smaller species of *Tragelaphus* into two groups, characterised by the presence or absence of the peculiar collar of short hairs which had been so

* [The complete account of the new species described in this communication appears here; but since the name and preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—EDITOR.]

† SB. Ges. nat. Fr. Berl. 1902, p. 98.

often noticed in Bushbucks, and which was evidently of definite systematic value. But, as Dr. Einar Lönnberg had shown *, several of Mr. Neumann's allocations were incorrect—certainly the Cape *sylvaticus* had a short-haired collar, and fell into the *scriptus* group, while the Nilotic *bor* had a well-haired neck.

Mr. Neumann had also stated that the forms with well-haired necks known to him did not have a darker underside, but since his paper was written Lönnberg's *knutsoni* and the present animal had both proved to present the combination of a hairy neck and a black belly. This combination therefore distinguished *haywoodi* from any of Mr. Neumann's species, while from the Cameroon *knutsoni* it was separated by its whitish dorsal crest, less numerous spotting, and other detailed characteristics.

In company with this handsome animal, which Mr. Thomas had much pleasure in naming after its discoverer, Mr. Haywood had sent home to the National Museum two immature skins, with skeletons, of the recently described Forest-Pig (*Hylochœrus meinertzhageni*). It was hoped that an adult specimen suitable for mounting would soon be obtained, and this Mr. Thomas looked forward to exhibiting to the Society in due course.

Mr. Oldfield Thomas also exhibited a series of Mammals and Birds from Japan as the first-fruits of an exploration of the islands of Eastern Asia conducted for the furtherance of science by the President, the Duke of Bedford, K.G., in order to show his Grace's sympathy with the technical side of the Society's work. The specimens obtained during this exploration would be laid before the Society from time to time, and papers would be read on them by various specialists, after which his Grace proposed to present them to the National Museum.

Mr. Thomas commented on the immense value such a systematic exploration would be to science if it were carried on for some time, and instanced the revolution in our knowledge of the mammals of South Africa—a region supposed to be well-known—which had been effected by the similar exploration conducted by Mr. C. D. Rudd.

The Japanese collection had been made by Mr. Malcolm P. Anderson, who had already proved his powers both during the Stone Expedition to Alaska and by the collections he had made in California.

Of the specimens now laid before the meeting Mr. Thomas drew attention to a fine Marten, which appeared to be different from the ordinary Japanese Marten (*Mustela melampus*) and which, as the first new mammal discovered on the expedition, he proposed to name in honour of the President: —

* Arkiv för Zoologi, Stockholm, ii. 15 (905).

MUSTELA MELAMPUS BEDFORDI Thos.*

Thos. Abstr. P. Z. S. No. 21, p. 10, June 13, 1905.

Size as in true *melampus*, or slightly larger. General colour above, in winter pelage, near "isabella," but rather darker and with an olivaceous tone, nearer to the yellowish brown of *M. m. tsuensis* † than to the golden yellow of *melampus*. Wool-hairs of back brown at base, then dark yellowish. Long hairs brown. Muzzle dark chocolate-brown, passing backwards, on the crown, into silvery greyish. Ears whitish both externally and internally. Nape more yellow than back. Sides of neck brilliantly yellow ("deep chrome"), sharply contrasted with the upper colour along a line halfway up the neck, and in continuation with the deep orange ochraceous of the chest-patch. Lips pale brown, lighter than the top of the muzzle; sharply defined from the whitish interramia, which in turn passes without line of demarcation into the orange of the throat and chest. Belly brown, not unlike back, the throat-patch extending to the sternum and continued in some specimens as an irregular line of spots to the inguinal region. Limbs deep brownish black from halfway down the forearms and on the hind feet. Tail pale brown for the greater part of its length, the underfur dull yellowish as on the body; tip sharply contrasted yellowish or cream-colour, forming a conspicuous terminal tuft.

Skull as in *tsuensis*, slightly larger than in *melampus* so far as material for comparison existed.

Dimensions of the type, measured in the flesh :—Head and body 425 mm.; tail 220; hind foot 87; ear 40.

Skull—greatest length 84; basal length 75; zygomatic breadth 48; interorbital breadth 20; mastoid breadth 37·5; palatal length 42; length of upper p^4 on outer edge 9·5.

Hab. Washikaguchi, Nara District, E. of Osaka, Southern Central Hondo, Japan.

Type. Adult male. B.M. No. 5.5.30.3. Original number 123. Collected 13 January 1905 by Malcolm P. Anderson, and presented by the Duke of Bedford. Four specimens.

This very handsome Marten is conspicuously different from the yellowish *M. melampus*, and is curiously more similar in general colour to the *M. m. tsuensis* of the Tsu-shima Islands. From both, however, it is readily distinguished by its brilliant yellowish throat and neck patches and its contrasted tail-tip.

Mr. R. I. Pocock, F.L.S., the Superintendent of the Gardens, exhibited a female specimen of the Jamaican Scorpion, *Centrurus*

* [The complete account of the new species described in this communication appears here; but since the name and preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—EDITOR.]

† Thos. Ann. Mag. N. H. (6) xix. p. 161 (1897).

insulanus, carrying its young on its back. The specimen had been presented to the Society by Mr. Henry Munt, F.Z.S.

Dr. P. Chalmers Mitchell, the Secretary to the Society, read a paper, illustrated by lantern-slides, entitled "On the Intestinal Tract of Mammals."

This paper will be published entire in the 'Transactions.'

The following papers were read:—

1. Rough Notes on the Natural History of the Country West of Lake Victoria Nyanza. By Lt.-Col. C. Delmé-Radcliffe, M.V.O., F.Z.S.

[Received June 6, 1905.]

These notes contain the general results of my observations on the Natural History of the region traversed by the Anglo-German Boundary Commission in the years 1902–4. Memoirs dealing more exactly with the collections that were made have already appeared in the 'Proceedings' of the Zoological Society (P. Z. S. 1904, vol. i. pp. 371, 459) and 'The Ibis' (1905, p. 199.).

Mammals.

Beginning with the larger mammals in the country under discussion, it may be stated that Elephants appear periodically in the swamps and forest near the mouth of the Kagera River on the northern side. These elephants stray in this direction, probably, at a time when it is dry in the interior. They come, no doubt, from the herds in northern Ankole and Toru. At no other point were traces of elephants seen except one single track going from north to south from the Koki hills towards the Busenya forest. In the west, a few elephants were noticed near the shores of Lake Albert Edward, also probably stragglers from the herds further north. There was no evidence of elephants crossing from south to north, or *vice versâ*, along the 1st parallel south latitude.

It may perhaps be assumed that the herds of elephants reported by E. S. Grogan and other travellers in the Mfumbiro district belong to the forest-regions of the west. The herds of elephants on the east of Lake Albert Edward and Ruwenzori probably do not wander into the Congo forests. It has been noticed that the elephants to the west of the great line indicated by Lake Tanganyika, Lake Kivu, Lake Albert Edward, Lake Albert, &c., and the Nile differ in many particulars from those lying to the east of this line. At the same time, it must be remembered that large herds of elephants are in the habit of crossing the Nile to

the north of Lake Albert, and there seems no reason why they should not extend their wanderings into the Congo forests, although so far observation tends to show that these herds find their way back again, as a rule, to the countries east of the Nile.

Hippopotami are not very numerous in the Victoria Nyanza near the mouth of the Kagera. The locality does not seem very well suited to them. In the Kagera River itself there are more, and parts of the river are infested by a number of very savage brutes that make navigation in canoes or small boats extremely dangerous. Lt. Weiss, of the German Commission, was repeatedly attacked when in a very large canoe. He was almost upset—one man was dragged out by the arm, but escaped. Finally his crew refused to go on and ran away with their paddles. The actual number of hippopotami cannot be considered large in comparison with the huge herds in the Nile north of Lake Albert. Probably in the great swamps of the Kagera, considerably to the south of the area traversed by the Boundary Commission, the hippopotami are much more numerous. The specimens secured in the Kagera were decidedly inferior in size and in development of ivory to those of the Nile.

Rhinoceroses are extremely numerous on the right bank of the Kagera, especially in Karagwe. The number of these animals is quite remarkable, and, according to accounts received, they are to be met with in even greater numbers a little further south. It is a curious fact that no rhinoceroses are to be found on the left bank of the Kagera. All those seen belonged to the common black African type. Stories were current of the existence of the White Rhinoceros on the right bank of the Kagera, but these rumours require confirmation. The rhinoceroses appear to have no hesitation in frequenting the extremely steep and difficult hills of Karagwe. Their tracks and signs were seen up and down hills and on ridges which appeared more adapted to the habits of klipspringers or goats than of such bulky animals as rhinoceroses.

In the virgin forest west of the lake near the mouth of the Kagera, in the swampy and open forest east of Koki, and in the Busenyi forest west of the Gambaizi group of hills, several herds of Buffaloes are to be found. These buffaloes are of a very interesting, new, large variety. They are, perhaps, the largest buffaloes in existence. In all, in the district referred to, there may be 400 or 500 buffaloes, and as their numbers are not likely to be interfered with, except by men armed with rifles, they may be considered to be firmly established again after the devastation caused by the great cattle-plague of some ten years back.

In Bukanga the buffaloes wander in search of young grass, after the fires, as far as the hills of Ankole and Koki, from the forests which form their strongholds. There is one disadvantage, however, connected with the presence of the Buffaloes, of the Eland, and perhaps of other Antelopes. This is the tsetse-fly, and it is to be feared that as long as large herds of buffaloes and the greater antelopes exist, so long will the tsetse-fly make it

impossible for domestic cattle and horses to live in the same part of the country. I myself lost an Arab horse I had had for six years in Africa and was very fond of. He was bitten by tsetse-fly in Bukanga.

Eland were met with at two points in Bukanga—near the Nyakafunzo swamp, and in the districts known as Mpororo and Rushenyi. In Bukanga there were herds amounting to, perhaps, 200 animals, and the uninhabited country surrounding the Nyakafunzo swamp seemed admirably suited to their needs. They were considerably preyed upon, unfortunately, by natives, who organised hunting-parties into this district both from the British and the German side. Still more unfortunately, the natives are sometimes armed with rifles. The result could be seen in many wounded animals observed from time to time, and in dead bodies found with bullets in them. Lions also take toll of the elands, but the natural decrease due to this cause is nothing compared to the damage inflicted by natives with firearms. Further west a herd of considerably over 300 elands was seen, and this, probably, is only an outlier of still greater herds in the open country further south. It seems, therefore, that this country is abundantly supplied at present with representatives of this magnificent antelope, which, I believe, might be made of great economic value. The meat is equal to the best English beef, and a bull eland weighs about 17 cwt.

Zebras occurred coincidentally with the Eland in Bukanga, and they number, perhaps, 400 individuals. In Rushenyi another very large herd of zebras was seen; and it may be remarked that in the Rushenyi herd a single zebra was seen almost entirely pure white in colour, a few stripes only appeared on the neck and hind-quarters. Another small herd of zebras, amounting, perhaps, to 150 individuals, was seen in the plains in southern Ruampara, on the left bank of the Kagera, just north of the point where the river turns from the south to east.

Roan Antelope were encountered, a few at a time, in Bukanga, in the narrow valley of the Kagera, and in south-west Ruampara north of the bend of the Kagera just referred to. They were occasionally met with in Rushenyi and Mpororo, and appeared more numerous in Karagwe, where for some reason there appeared to be no Eland, no Zebras, and no Damaliscus. These last were the common hartebeeste throughout the area west of the lake. In Bukanga, Damaliscus were very numerous. The number in this part may be estimated at 1000 individuals. No other variety of hartebeeste made its appearance: 200 or 300 individuals were found with the herd of zebras in south-western Ruampara, and in Rushenyi and Mpororo the Damaliscus hartebeestes are very numerous.

The Nile Valley variety of Water-buck (*Kobus defassa*) is common in Bukanga, and may be met with in herds up to a dozen or fifteen individuals. They also appear fairly plentiful throughout the valley of the Kagera and in western Ruampara, but

apparently not further west. These water-buck have fine heads, as a rule considerably larger than *K. ellipsiprymnus* in East Africa, although the heads are not nearly so big as are found in the Semliki Valley.

In the swamps near the mouth of the Kagera, on the shores of the lake, and on the islands of the Sesse group, *Limnotragus spekei* was fairly common. This animal, owing to its nocturnal and swamp-loving habits, is of course seen extremely rarely, but it is frequently hunted by natives with nets and packs of dogs. The horns are often to be met with in possession of natives. There is at present a doubt whether more than one species of this antelope is not found in the same district.

In Bukanga, especially about the Nyakafunzo swamp and to the south of it, large herds of Mpala (*Æpyceros melampus*) may be met with. These beautiful antelopes are to be seen in herds of 200 or 300, and in the district referred to perhaps 1500 individuals exist at the present time. They were met with at no other point throughout the country traversed.

Very common, although occurring only in ones and twos at a time, was a species of Reed-Buck (*Cervicapra?* sp.). This antelope was chiefly confined to the low-lying grassy country in Bukanga, along the banks of the Kagera, and in Ruampara.

Another very common antelope was the Oribi (*Ourebia montana*). This little antelope appeared almost everywhere on the low ground in the mountains, except in the highly cultivated parts of Ankole and the mountains in the west. In general, it may be said that no antelopes or game animals of any description were seen in the Ruchigga mountains and their northern and eastern extensions. Bush-buck and Harnessed Antelope were seen at rare intervals in the valley of the Kagera. The latter appeared occasionally at the edges of the dense forests near the mouth of the Kagera, and in one or two places in the narrow valley of the Kagera between the mountains.

Bush-buck were occasionally seen in the Koki hills and the mountains of Ruampara, where the deep gullies choked with vegetation afforded them shelter, and the open grassy hillsides excellent feeding-grounds.

On the steep hills of Ankole and Karagwe, Klipspringers were common wherever the ground suited them. The form in this country shows some differences when compared with the klipspringers of other parts of Africa, and may prove to be an intermediate variety.

Of Monkeys, *Colobus guereza* was seen in the forests near the lake. The common grey African monkey was also observed in many places, and an interesting species, *Cercocebus aterrimus*, was also seen in the dense forests near the lake and in the dense forests round Minziro. The last-named monkey looks almost black and is very shy. Its cry is very loud and peculiar, reminding one slightly of the cry of the Chimpanzee. Baboons are common, especially in the mountains in Ankole and Karagwe.

Wart-Hogs (*Phacochœrus æthiopicus*) were occasionally to be met with all along the valley of the Kagera, though nowhere very numerous. Aardvark were present, though of course never seen unless dug for. Their holes, however, were found in all directions in the low-lying country, and they are probably fairly common.

Of beasts of prey Lions are fairly common in Bukanga, in the neighbourhood of the Nyakafunzo swamp. They also appear in western Ruampara and in Rushenyi and Mpororo. In general terms, it may be said that they are to be found wherever large herds of zebras and antelopes exist. In Bukanga, however, it appears that they have taken to man-eating fairly extensively. The natives in this part of the world have a wholesome dread of them, and during the short time the Boundary Commission was at work in Bukanga repeated instances occurred of lions attacking human beings.

Leopards are also found throughout the whole area under discussion except the extreme western portion. Although they live principally on the small antelopes, monkeys, guinea-fowl, &c., they also take toll of the natives' goats, &c., and thus become sometimes a great nuisance. At Mulema camp, for instance, a leopard took goats from one hut or the other almost every night for a month, and when Captain Laughlin, Dr. Bagshawe, and Mr. Doggett endevoured to kill him at the natives' request, he wounded, more or less seriously, no less than thirteen men before being finally despatched. Cheetahs apparently do not exist in this part of the country west of the lake. Serval Cats were occasionally met with, and a smaller grey, rather long-tailed Wild Cat. Hyænas appeared occasionally, but may be said to be rare. They were of the usual spotted variety.

Otters are common in the lake. Two forms were met with, one very large, the other smaller. These two are stated also to be common in Lake Kivu.

Among smaller mammals, interesting species were a *Pœcilogale doggetti*, an extremely handsome, large, striped Stoat; *Tatera fallax*; *Procavia bettoni*: these three being new species. Another extremely interesting animal was *Herpestes galera robustus*, a fish-eating Mongoose.

In all about 180 specimens of mammals were collected, and a large number have been described in the 'Proceedings' of the Zoological Society of London, the most interesting being the new Buffalo (*Bubalus caffer radcliffei*), *Pœcilogale doggetti*, *Tatera fallax* and *Procavia bettoni*. There is no doubt that a scientific investigation would disclose a much larger number of small mammals than were secured for the collections of the Boundary Commission. All the region west of the lake abounds with species of great scientific interest, the interest increasing the further west one goes, and it is a matter for the greatest regret that a collection could not be made in the neighbourhood of the Mfumbiro Mountains.

BIRDS.

Lake Victoria is a disappointing sheet of water in bird-life as in fishes. Birds are of course present, but not in the vast numbers so extended a sheet of water in the heart of Africa might lead a naturalist to expect. The reason is probably to be found in the fact that the food-supply in the lake is very deficient for birds and fishes alike—for many species of birds in consequence of the poverty in fish.

The White-headed Fish-Eagle (*Haliaëtus albicilla*) is fairly common all round the lake-shore and up the Kagera River. This bird is invariably found in pairs, and appears to divide the districts into beats, each containing its pair of fish-eagles in possession. Their cheerful squalling, as described by Sir Harry Johnston, is one of the most familiar sounds near African river and lake.

An Osprey may also occasionally be seen on Lake Victoria seizing fish on the surface of the water in a manner peculiar to its kind

A species of *Plotus* is fairly common, and may be seen in small congregations at certain points where the ambatch or rocks afford a convenient spot for perching and hanging their wings out to dry.

With them may also be seen the large Cormorants, which here and there form communities numbering several hundreds. The northern end of the island Usuwgwe and the small rocky Mwasambwa Islands and Dumo Point are favourite haunts of all these birds.

A large Gull, resembling the black-backed gull at home when on wing, is also not uncommon close in-shore and especially in the rivers.

The Pied Kingfisher is fairly common inland. The two varieties of brilliant-hued Kingfishers appear to forsake their occupation of fishing to devote themselves entirely to the capture of insects.

Herons are fairly plentiful in the swamps and at the edge of the lake. The most conspicuous amongst these is the Goliath Heron, a bird whose immense span of wing can be fully appreciated when, disturbed by a canoe, he flaps slowly across the Kagera River. The common Grey Heron is also a familiar sight, and at times flocks of the White Egret. Night-Herons are fairly common along the Kagera River.

In the lake, Egyptian Geese and Spur-winged Geese may be seen in small numbers; Pigmy Geese are not uncommon near the lake-shore, where the open reeds afford them shelter.

Yellow-billed Ducks are perhaps the commonest of the ducks on Lake Victoria. Throughout the course of the Kagera River no ducks and geese were observed until reaching the Rufua River, and especially the Karenge Lake. The latter seems a favourite haunt of wild-fowl, and for this region of Africa is very well supplied with water-birds of all descriptions.

Huge flocks of Pelicans are to be seen, and large numbers of Pochards and Yellow-billed Duck; also Egyptian Geese.

A few Pin-tailed Ducks were also seen, but no Mallard at any time.

Teal are not uncommon; and in the Rufusa Stream and the swampy streams draining the Karenge Lake the Snipe were fairly numerous in December and January.

Along the lake-shore, especially among the ambatch trees, were vast communities of Weaver-birds. No less than seventeen forms are represented in the collection of these, many belonging to the brilliant species found inland.

Ibises are not uncommon near the water. The Glossy Ibis is a common bird, and most travellers are familiar with its exasperating cry when disturbed. The Sacred Ibis, on the other hand, is much shyer, and confined to larger and remote sheets of water.

Crowned Cranes are common, especially in the west.

Bustards are not uncommon, especially in the open cattle-country in the west, about December. Denham's Bustard, the large red-necked species, was frequently seen.

Pigeons are not often seen, but the Doves in places were very numerous indeed, especially in Bukanga.

Parrots were scarce, except the one small species collected. Grey Parrots, so common in Uganda, were never seen near the Kagera.

Birds of Prey were represented by the Bateleur Eagle and another species which was frequently observed pursuing guinea-fowl.

Vultures were rarely seen except in Bukanga, where the lions provided them with frequent meals.

It is worth noting that in April a migration of Hobbies appears to pass through the country. Enormous numbers of this handsome little falcon were seen at the same time busily engaged in pursuing locusts, large clouds of which appear to make their appearance at the same time.

In the neighbourhood of the lake Hornbills of two species are common, and Touracoes of two species make their appearance in the dense forests.

An interesting bird was the Honey-guide, which in Bukanga and the narrow valley of the Kagera River very frequently provided us with honey by leading to the nests of wild bees.

Goatsuckers are common, and in March, April, and May the pennant-winged species became very conspicuous, as when the long feathers are developed the bird has the appearance, when on the wing, of a toy Japanese kite.

Three species of Bee-eaters were seen, but the Roseate Bee-eater of East Africa and the Nile countries did not make an appearance.

The birds belonging to the scrub and open forest country, the Barbets, Woodpeckers, Pittas, Swallows, Flycatchers, Thrushes, Shrikes, Tits, and Finches, were never to be seen in large numbers, though appearing in isolated parties sufficiently often to preserve the district from the appearance of lifelessness, which is a disappointing feature in other parts.

The Larks and Pipits were, on the whole, very scarce. An extremely handsome Glossy Starling was a very conspicuous bird, which seemed to like the neighbourhood of camps. The White-necked Crow and the fine Razor-billed Raven were especially common in the west; and it was in the cattle country and on the Ruchigga Mountains that the Tick-birds (*Buphaga*) were observed, although some were seen following large herds of elands in Bukanga and Mpororo, and the rhinoceros in Karagwe.

Perhaps the most noticeable feature in the bird-life was the extraordinary number of Francolins of every species to be seen in Bukanga. Every valley and almost every patch of dry grass appeared to contain a large number of these birds. In the evenings, when the grass had been burnt in patches, numbers of Francolins could be observed feeding in the open like pheasants outside a cover in September at home. It would have been easy to have shot forty or fifty brace a-day if time and cartridges had been available.

2. The Distribution of Mexican Amphibians and Reptiles. By Hans Gadow, F.R.S., F.Z.S.

[Received May 17, 1905.]

(Text-figures 29–32.)

Contents.

Introduction.

These investigations are based upon a considerable material which it is convenient to enumerate:—

1. The volume on Reptilia and Batrachia, by Dr. Günther, of the 'Biologia Centrali-Americana,' with its thousands of references to localities.

2. Cope's posthumous work, 'The Crocodilia, Lizards, and Snakes of North America,' Rep. U.S. National Museum for 1898.

3. Boulenger's Catalogue, with the lists of ever-increasing additions, of the Collection in the British Museum of Natural History.

4. Collections made by Dr. Meek during his ichthyological

tours through many States of Mexico. These, and others, I have been able to examine owing to the courtesy of the officials of the Field Columbia Museum, Chicago. Dr. Meek has, moreover, given me much verbal information about the physical aspects of the places visited by him.

5. There is a fair number of native specimens in the Governmental Museums and other Institutions of various towns in Mexico; for instance, in Mexico City, Orizaba, and Oaxaca, but the labels vouchsafe at best no further trustworthy information than "Mexico" or "La República."

6. Lastly, the material which I have collected myself, or noted down, during two journeys in Mexico, notably in the Valley of Mexico, the States of Vera Cruz, Oaxaca, Guerrero, Morelos, and Puebla, and in the neighbourhood of Zapotlan s. Guzman in Jalisco, especially the Nevado de Colima. The features of the Central and Northern plateau, except the vicinity of El Paso, I know only from several rapid transits, quite enough, however, to gather the main aspects of this enormous stretch of country. Moreover, here Dr. Meek's information has been especially welcome. Valuable for comparison, but of too short a time for serious collecting, were a few days passed in New Mexico, the Grand Cañon of Arizona, the Californian Desert, and the neighbourhood of San Francisco.

A few words are necessary as to the way in which I have marshalled the thousands of data. The reputed localities were marked down on an outlined map of the Republic, a separate map for each species. In this way alone generalisations could be formed, often at a glance, concerning the distribution of the species and genera. Many localities, at first suspicious, revealed themselves as very doubtful or as obviously erroneous on further reference to the original papers.

It was also found that the number of different localities is astonishingly small, less than 100, although they now cover a fair portion of the whole country. With the exception of 20, all these localities lie south of the line Guadalajara, Guanajuato, Tampico. The whole State of Michoacan and the western half of Guerrero are still an almost absolute terra incognita, but to judge from what I have found in Middle Guerrero and what is known from Colima, the fauna seems to be rather continuous. However, the basin of the Lower Balsas and thence to Colima will in all probability yield much of interest to whoever will brave these inhospitable and positively unknown regions.

Both Godman (introduction to the volume on Rhopalocera) and Günther, in their statistical tables, have divided Mexico simply into Northern and Southern by an absolutely arbitrary line which runs from Mazatlan to Tampico right across the country! They have done this in spite of their correct statements about the main physical features of Mexico, the unmistakable continuation of North American forms over the Plateau, and the extension of

Southern or Central American forms northwards into the Pacific and the Atlantic borderlands embracing this Plateau. The two columns in these tables are of no use, they are even misleading. Günther has properly taken off Yucatan as a separate district. Cope's division (*op. cit.* p. 1206) into a Sonoran, Austroriparian,

Text-fig. 29.

Map of Mexico.

and Toltecan subregion of Blanford's Medi-Columbian region, and the Atlantic + Pacific Tierra Caliente as belonging to the Neotropical region, is excellent when taken broadly; but his subdivision of the Toltecan into an Oriental, Central, and Occidental province is a failure.

List of Species collected by myself during the months of June to October 1902 *and during* 1904.

Dermophis mexicanus.	San Juan Evangelista.
Amblystoma tigrinum.	Lake Xochimilco.
„ *altamirani.*	Dos Rios. Contreras, Sierra de Ajusco.
Thorius pennatulus.	Citlaltepetl, 9000′; Cerro de S. Felipe, Oaxaca, 8250′.
Spelerpes orizabensis.	Citlaltepetl, 8000–12,500′.
„ *leprosus.*	„ 8000–11,500′.
„ *chiropterus.*	„ 9000–10,000′.
„ *variegatus.*	Orizaba, Presidio S. of Cordoba, Tetela, S. Juan Evangelista.
„ *belli.*	Omilteme.
Batrachoseps attenuatus.	Nevado de Colima, 7000′.
Scaphiopus dugesi.	Totolapan, S. Oaxaca.
Rhinophryne dorsalis.	Presidio; Agua fria.

Bufo valliceps.	Orizaba, Presidio, Motzorongo, Tetela, Agua fria.
„ *marinus.*	Tetela, San Mateo del Mar, Tehuantepec; Iguala, Tierra Colorada; San Luis Allende.
„ *marmoreus.*	Salina Cruz; Cocoyul, Tierra Colorada, Cajones 3000′, Chilpancingo, Rio Balsas, Iguala.
„ *intermedius.*	Tetela, Totolapan, Oaxaca; Omilteme, Chilpancingo.
Hyla baudini.	Presidio, Motzorongo, La Raya; Tierra Colorada. San Luis Allende.
„ *eximia.*	Tacubaya near M. C., Buena Vista.
„ *staufferi.*	Motzorongo.
„ *copei.*	Chilpancingo, Mazatlan, Cajones.
Phyllomedusa dacnicolor.	Rio Balsas; San Luis Allende.
Hylodes rhodopis.	Citlaltepetl, 8000–12,500′; Motzorongo, Agua fria; Nevado de Colima, 8000′.
„ *beatæ.*	La Perla, North of Orizaba.
Eupemphix gadovii.	San Mateo del Mar.
Leptodactylus albilabris.	Agua fria, Salina Cruz, Cocoyul.
„ *caliginosus.*	S. Juan Evangelista; S. Mateo del Mar, Salina Cruz, Tequesixtlan; Cocoyul, Pacific Camp, San Luis, Tierra Colorada.
Borborocœtes mexicanus.	Omilteme, 7500′; Nevado de Colima, 8000′.
Syrrhopus verruculatus.	Buena Vista, S. Guerrero.
Paludicola mexicana.	Chilpancingo.
Engystoma ustum.	Presidio and Motzorongo.
Rana montezumæ.	Xochimilco, Chalco, Zapotlan.
„ *halecina.*	Mexico, Orizaba, Motzorongo, La Raya, Agua fria, Salina Cruz, Tequesixtlan, near Totolapan; Cajones, Buena Vista, Tierra Colorada, Limon; Omilteme.
„ *palmipes.*	Motzorongo, Tequesixtlan; Cuernavaca.
Crocodilus americanus.	La Raya, Agua fria, Rio Balsas, Pacific Camp.
Caiman sclerops.	Agua fria.
Cinosternum integrum.	San Mateo del Mar; S. Dionisio, Zapotlan.
„ *effeldti.*	San Mateo.
„ *leucostomum.*	
„ *pennsylvanicum.*	San Luis Allende.
Dermatemys mawi.	Tetela.
Nicoria rubida.	Tetela, Agua fria, San Mateo del Mar.
Chrysemys grayi.	San Mateo.
„ *ornata.*	San Mateo.
Chelone viridis.	San Mateo; Pacific Camp.
Sphærodactylus glaucus.	Salina Cruz.
Phyllodactylus tuberculosus.	Totolapan; Pacific Camp, San Luis, Tierra Colorada.
Coleonyx elegans.	Cocoyul.
Holbrookia texana.	Juarez, El Paso.
Uta elegans.	Juarez; San Marcial, N.M.; Grand Canyon, Arizona.
„ *bicarinata.*	Salina Cruz, Tequesixtlan, San Bartolo, Totolapan, Rio Balsas, Iguala, Mesquititlan, Chilpancingo, Tierra Colorada, Cocoyul.
„ *irregularis.*	Cocoyul, San Luis Allende.
Phrynosoma asio.	Salina Cruz, Tequesixtlan; Rio Balsas.
„ *modestum.*	Juarez, El Paso; San Marcial, N.M.
Sceloporus torquatus.	Xochimilco; Chilpancingo; Zapotlan, Nevado de Colima.
„ *spinosus.*	Totolapan.
	Cuernavaca, Iguala, Rio Balsas, Tierra Colorada, Ayutla.
„ *acanthinus.*	Oaxaca, Cerro S. Felipe, 6000′; Omilteme.
„ *formosus.*	Oaxaca; Chilpancingo; Nevado de Colima, 7000–6000′.
„ *pyrrhocephalus.*	Iguala, Rio Balsas.
„ *æneus.*	Citlaltepetl, up to 13,700′; Contreras.

Sceloporus scalaris.	Contreras.
	Chilpancingo, Tierra Colorada, Rio Balsas.
„ *variabilis.*	Orizaba, La Perla; Mexico, Presidio, Motzorongo, La Raya, Tetela, Agua fria. Chilpancingo; Nevado de Colima, 7000–6000′.
„ *siniferus.*	San Mateo del Mar, Tequesixtlan, San Carlos Yautepec. From Pacific Camp to S. Luis, Tierra Colorada, Buena Vista, up to southern slope of Los Cajones.
„ *melanorhinus.*	Tierra Colorada, Cocoyul, San Luis.
„ *microlepidotus.*	Citlaltepetl, up to 13,500′. Xochimilco, Contreras. Iguala; Omilteme, Nevado de Colima.
„ *gadoviæ.*	Mesquititlan between Mescala and Chilpancingo.
Corythophanes hernandezi.	Motzorongo.
Basiliscus vittatus.	Motzorongo, Agua fria, Huile; Tequesixtlan Tierra Colorada, Ayutla.
Iguana rhinolophus.	Tetela, Agua fria; Tequesixtlan, Totolapan.
Ctenosaura acanthura.	Tetela, Agua fria; Tequesixtlan; Cuernavaca, Iguala, Tehuantepec, Salina Cruz, San Mateo. Rio Balsas, Tierra Colorado, Cocoyul, Pacific Camp.
„ *quinquecarinata.*	Salina Cruz, Tequesixtlan.
Ameiva undulata.	Presidio, Agua fria; Cocoyul forest; North and South below Los Cajones.
Cnemidophorus gularis.	Puente de Ixtla. Rio Balsas. Chilpancingo. Cuernavaca.
„ *mexicanus.*	Oaxaca.
„ *bocourti.*	Oaxaca.
„ *deppei.*	San Juan Evangelista. Tehuantepec; Salina Cruz; Tequesixtlan; Totolapan; San Carlos. Rio Balsas. Tierra Colorada; Cocoyul; Pacific Camp; San Luis Allende. Ayutla.
„ *striatus.*	Salina Cruz; Totolapan; Tierra Colorada; Ayutla; San Luis; Cocoyul.
„ *guttatus.*	Agua fria.
Anolis sallei.	La Perla near Orizaba.
„ *tropidonotus.*	Motzorongo, La Raya.
„ *nebulosus.*	Cuernavaca. Tierra Colorada; Cocoyul, San Luis Allende, El Coquillo; Nevado de Colima up to 7000′.
„ *gadovii.*	Tierra Colorada.
„ *liogaster.*	Omilteme, 7600′.
Gerrhonotus gramineus.	Citlaltepetl, 8000–9000′.
„ *antauges.*	„ 12,000′.
„ *deppei.*	„ 8000–10,000′.
„ *imbricatus.*	„ 8000–10,000′; La Perla; near Mexico, 7800′; Nevado de Colima up to 11,000′.
„ *liocephalus.*	Omilteme, 8000′.
Eumeces fuscirostris.	Nevado de Colima.
„ *lynxe.*	„ Omilteme 8000′.
Mabuia agilis.	Salina Cruz, Tequesixtlan; Tierra Colorada, Cumbre del Coquillo, Buena Vista, Cocoyul.
Lygosoma laterale.	La Perla.
Anelytropsis papillosus.	Motzorongo.
Chirotes canaliculatus.	Rio Balsas.
Glauconia albifrons.	La Raya; Chilpancingo.
„ *dulcis.*	Rio Balsas; Chilpancingo.
Boa imperator.	Motzorongo. North of Rio Balsas; Coquillo.
Tropidonotus melanogaster.	Xochimilco. Nevado de Colima.
„ *scaliger.*	Xochimilco.
„ *ordinatus,*	
var. *eques.*	Xochimilco. San Mateo del Mar.
var. *marcianus.*	Rincon, N.M.
„ *scalaris.*	Citlaltepetl, 8000–12,000′.
„ *chrysocephalus.*	Omilteme.

Contia nasus.	Contreras.
Zamenis mentovarius.	San Mateo, Tequesixtlan.
„ *mexicanus.*	Rio Balsas, Cocoyul.
„ *pulcherrimus.*	Salina Cruz.
„ *lineatus.*	Iguala.
Coluber oorais.	La Raya; Tequesixtlan; Ayutla.
Coronella micropholis, var. B.	Chilpancingo, San Luis Allende.
Urotheca elapoides.	La Raya.
Drymobius margaritiferus.	Motzorongo, Agua fria, San Juan Evangelista.
„ *boddaerti.*	Motzorongo, La Raya.
Leptophis mexicana.	Motzorongo, La Raya.
„ *diplotropis.*	San Mateo del Mar.
Rhadinea decorata.	Presidio.
„ *clavata.*	Tetela.
„ *vittata.*	La Raya, Salina Cruz, Tequesixtlan, Totolapan; Omilteme, Chilpancingo.
Streptophorus atratus.	Presidio, Motzorongo, La Raya.
Geophis semidoliatus.	Orizaba.
Geagras redimitus.	San Mateo del Mar.
Trimorphodon upsilon.	Cuernavaca, Rio Balsas.
„ *biscutatus.*	Tierra Colorada.
Himantodes cenchoa.	La Raya.
Leptodira personata.	Rio Balsas, Ayutla.
„ *albofusca.*	Cocoyul, San Luis; Nevado de Colina.
„ *guilleni.*	Rio Balsas.
Conophis vittata.	Salina Cruz, Tequesixtlan.
Homalocranium miniatum.	Tezonapan, N. of Ayutla.
Manolepis putnami.	Los Cajones.
Petalognathus nebulatus.	La Raya.
Dryophis acuminatus.	Motzorongo.
Elaps fulvius.	La Raya, San Juan Evangelista.
Lachesis lanceolatus.	Motzorongo, La Raya.
„ *atrox.*	Motzorongo.
Crotalus terrificus.	Tequesixtlan.
„ *triseriatus.*	Citlaltepetl, 9000–12,500′; Nevado de Colima.

Physical Features.

A list of the names of the localities where collections have been made should be supplemented by *a short description of the chief physical features*; without these it is of no more use than the bare mentioning of the name of the political country. The "altitude" is supposed to be all-sufficient; but this is a great mistake, since it conveys nothing without further information. For instance, 2000 feet on the Atlantic slope means typical tropical hot-country vegetation, while on the Pacific side (*e.g.* Oaxaca and Guerrero) the same elevation implies pine- and oak-forests, with a character devoid of tropical fauna and flora. Mexicans divide their country into the Tierra Caliente, Templada, and Fria, with a hot, temperate, and cool climate respectively; the Tierra Templada corresponding on an average with an elevation of 3000 to 5000 feet. But the natives of the State of Vera Cruz draw the imaginary line at a level very different from that used by the citizens of Puebla. Chilpancingo, 4100 feet, in Guerrero, has a much cooler climate, with nothing tropical about its vegetation, than Oaxaca, 5060 feet, or even Orizaba at 4027 feet, which is in many respects subtropical.

Valley of Mexico, 7600 feet. Alluvial; swampy meadows to west and south. Lake Texcoco brackish. Lakes Chalco and

Xochimilco freshwater, surrounded by meadows, wooded hills with streams.

Sierra de Ajusco, volcanic, well-wooded mountains. Contreras, 8090′; Dos Rios, 8800′, pines. Orizaba, 4027′; on the east side of the slope of the plateau; valley with streams, pastures, and rich vegetation, on alluvial and hard-limestone terrain. Thence gradual ascent to the volcano Citlaltepetl; dense mixed forest, oak, arbutus, and pines, about 9000′; giving way entirely to pines. Tree-line about 13,500′; then tussocks of grass. Snow-line about 14,500′.

Cordoba, 2700′. Dense tropical vegetation. Thence southwards, through limestone terrain, along the foot of the slopes, which are covered up to the edge with luxurious forests; eastwards bordered by savannahs. Permanent rivers with high banks; lagoons in the forests and savannahs.

Motzorongo, Presidio, and La Raya, about 1500′, in forest land.

Tetela, about 900′, near the edge of the savannah.

Agua fria, 100–200′; lagoons, swamps, and low forest; flat country, subject to inundations. The Rio Papaloapan, with its many tributaries, carries an enormous volume of thick, yellow water; much of the lower basin is for months under water, only island-like parts standing out, used as refuges, although by no means sanctuaries, by the game and other creatures.

Then follows low, undulating, rolling, cattle-grazing land, with sandy subsoil.

San Juan Evangelista, 100′. Tropical river-bed through savannahs, bordered by dense lowland forest.

Isthmus of Tehuantepec. Eastern slope, dense humid evergreen forest; on the ridge, less than 1000′, open country with temporary stagnant lagoons; on the western slope prevails the dry Pacific type without continuous forests, but with more scattered patches of mostly deciduous trees.

Tehuantepec, 120′. Sandy, varied terrain.

San Mateo del Mar. Sandy, lagoons connected with the sea. Flat, scanty vegetation except in occasional swamps or near the lagoons, some of which are fringed with dense low brushwood and small trees.

Salina Cruz. Porphyritic terrain; hilly, steep coast-range, varied by promontories and fresh- and salt-water lagoons.

From Salina Cruz and Tehuantepec northwestwards to Oaxaca.

The coast-range, averaging 2000–3000 feet, is covered with pines down to 2000 feet. Tequesixtlan, 560′, in a river-valley, shut off by the coast-range; varied, rather low vegetation, volcanic alluvial. Thence through mountainous country, across parallel ridges. Hills at first with tropical vegetation; oak-forests from 3000′ upwards, then pines prevailing, but nowhere continuous forests. General character of the country dry, most of the smaller rivers run dry except in the rainy reason. An intricate system of

hills, deep gorges with sandy river-beds and patches of xerophile vegetation, especially cactus.

San Bartolo, 2800′; San Carlos, 2460′, in more open country. Totolapan, 2800′, in broad, sandy river-valley. Thence steep ascent on to the plateau, the edge of which is 5300′. Looking back, southwards, over the many ridges of mountains and hills, the Tierra Caliente appears to be densely covered with wood, while towards the north stretches the flat, almost treeless Southern Plateau, here and there with outcropping low ridges which are barren when of volcanic, wooded when of Palæozoic formation.

San Dionisio and Tlacolula, 5160′; Oaxaca, 5060′. The Palæozoic terrain stretches from Oaxaca westwards. There is the forest-clad Cerro de San Felipe, 9000 feet high, with semialpine meadows on its slopes.

From Cuernavaca southwards to the coast.

Cuernavaca, 5000′. Fertile valleys of volcanic and limestone terrain, with little streams. Shut off from the Valley of Mexico by the high, volcanic, densely wooded Sierra de Ajusco, &c., averaging 10,000 feet.

Puente de Ixtla to Tetecala. Pleasant, fertile, varied open country; limestone terrain, in which are the huge Caves of Cacahuimilpa.

Iguala, 2400′, in a wide plain, surrounded by limestone hills, with scanty vegetation.

Rio Balsas Station, 1500′; in the valley of the Balsas or Mescala River. Very mountainous; tropical vegetation. High and low forest, interspersed with much brushwood. The river, during the rainy season, brings down floods of yellow or brown water with rather little sand, but much comminuted vegetable matter. The bed is rocky, limestone, the banks mostly steep, but there are many sandy shelves above the high-water mark. Mescala, 1700′.

The Balsas basin is bordered on the southern side by a long and high range of mountains, parallel with the Pacific coast, attaining heights of 10,000 feet, densely wooded, intersected by very deep, steep, and long gorges, and the river-beds are the only available roads; here and there these river-beds broaden out into meadows.

Mesquititlan, 2800′. Narrow, luxuriant gorges.

Zumpango, 3400′. Open, sandy, meadows.

Chilpancingo, 4100′. In a windswept, shallow depression of Cretaceous terrain, surrounded by sparsely wooded hills, and meadows on the top of the ridge.

To the west, in the mountains the hamlet of Omilteme, 7100′, luxurious forests; at first oak, dwarf palms and pines; then oak, pine, and arbutus; then oak and pine; and lastly pines up to the highest summits, forming dense high forests, with the most luxurious underwood in the gorges, especially within the cloudbelt.

Mazatlan, 4200′. Meadows and fields.

Cumbre de los Cajones; the pass at 3500′ over a ridge which, on the south flank of the main range, marks the beginning of volcanic terrain. Oak and pines and columnar cactus.

Buena Vista, 2300′. Wide meadows, with pools in the rainy season; low hills with oak and pines.

Typical Tierra Caliente, with an essentially tropical aspect of flora and fauna, begins on the southern slopes of the main ridge, coinciding with what is officially and locally known as La Costa. Its upper limit may be put at not higher than 1000 feet. In the depressions between the successive parallel ranges of hills the type is absolutely tropical and southern, but the country loses this character at once on the ridges which rise higher than 1500 feet.

Tierra Colorada, 990′; river valley, volcanic. Andesite overlaid with red rubble.

Valley of the Omitlan River, 500′. Limestone, densest vegetation on the slope which culminates in a ridge of 1600′, called El Cumbre de Coquillo.

Coquillo to Chacalapan, about 700′; tropical life.—From here, across several smoothed down ridges and to the coast, the subsoil consists of gneiss and granite in rapid decomposition, fairly well wooded in clumps or large patches, often interrupted by meadows and natural stretches of pasture. Numerous small rivers, carrying much sand, but nearly always with clear water, but most of them are liable to run dry in the winter. Near the granite-bound coast are numerous lagoons, mostly of fresh water, and there is a broad belt of almost impenetrable high forest, which in many places touches the sea. The mangrove-swamps of course are permanent, but during the rainy season many parts of these forests are inundated.

Limon, 1800′. Open, dry grass country.

Teconapan, 1500′. Broad meadows.

Ayutla, 1200′. Permanent river; rich vegetation.

Cocoyul, 160′. Near the coast forest.

Pacific Camp. Near the shore, 99° W., 16° 36′ N. Close to the forest; large lagoons and swamps; granitic rocks and mangroves.

San Luis Allende, 930′. Broad river-valley, with well-wooded hills which are covered with various kinds of oak, and from 1900′ upwards chiefly with pines.

Nearly the whole Coastal District is, during and after the rainy season, covered with a dense mass of tall herbs, which between the trees especially take the place of underwood.

CÆCILIÆ.

Dermophis mexicanus.—This is the only Cæcilian which extends into the Mexican Tierra Caliente. Previously known to range from "Tehuantepec" to Panama, I found it in the low woods near San Juan Evangelista. The American ancestral home of this circum-tropical family is South America, and none are known to occur on the Antilles or on the Galapagos. It is therefore

interesting that these burrowing, slowly moving worm-like creatures have managed to travel over at least 1500 miles of ground, covered with humus, since the close of the Miocene epoch, *i. e.* since the separation of the Antilles (*cf.* p. 237). A not unreasonable computation of one million years carries us back into the Miocene epoch. The rate of spreading could in this case have been extremely slow, only about one mile in 700 years, and this works out at three yards a year. Of course this is mere speculation, but it may be as well to give even such an imaginary instance of slow spreading. The fact remains that *Dermophis* has done it, and whether we double or treble the rate of progress, or increase the time two- or three-fold, the result remains within very reasonable possibility.

URODELA.

The *Amblystomatinæ* are a pre-eminently Eastern Palæarctic group; only two out of eight genera occur in North America: *Dicamptodon ensatus* in California, and *Amblystoma*, with some 16 species, on the North-American Continent, and one, *A. persimile* in Siam. In Mexico only two species occur.

Amblystoma tigrinum, the larval form of which, when permanent, is the famous Axolotl. This species has an enormous range, from the State of New York to Dakota and Colorado, whence, apparently now with wide gaps between, it extends through Mexico, as far south as the valley of Mexico City. But its distribution in Mexico is, at least now, restricted to the western Sierra Madre and the southern part of the Mexican plateau.

Well-ascertained localities of this species are the following:—West of Chihuahua Town; West of the town of Durango; Cumbre de los Arrastrados in Jalisco; somewhere N.W. of Guadalajara; district of Autlan in Jalisco; Lake Patzcuaro in Michoacan, Valley of Mexico, notably Lakes Xochimilco and Zumpango (but not Lake Texcoco, to which alone Weismann's dismal dream to account for the permanent Axolotl stage could apply!). Possibly there are *Amblystoma*, either metamorphosing or as Axolotls, in or near some of the other lakes of Michoacan and Jalisco, but they have as yet not been recorded from Lake Chapala; and I found none in the Lakes of Zapotlan; nor were such creatures, or even the name Axolotl, known to the natives.

A. altamirani.—This species, which metamorphoses regularly into a gill-less Newt, is known only from the streams of the mountains which border the western and south-western side of the Valley of Mexico. It was discovered in the Montes de las Cruzes, about 15 miles to the west of Mexico City, at an altitude of 8800 feet. In 1902 I found it also above Contreras, in the Sierra de Ajusco, some 12 miles south-southwest of the city, at an altitude from 8500 feet upwards to 8800 feet. Further up the rivulets are apparently too small. I stated in 'Nature,' Feb. 5, 1903, that searching in the streams only a little above the City of Mexico,

which lies at an altitude of about 7600 feet, was fruitless. In the month of September 1904, however, when we revisited this district, I was able to ascertain that these Newts live regularly in the stream below Contreras (altitude 8090 feet) down to about 7900 feet, where the stream leaves the hills, and runs, still swiftly, in its stony bed through the Pedregal, or recent field of lava, then through rich evergreen meadows into Lake Xochimilco. Moreover, I can now add with certainty that *A. altamirani* is absolutely aquatic throughout its life. The natives (millers, field-labourers, and boys) knew the creatures well. They called them "axolotes sordos" (deaf, having no ears), and described them as *axolotes sin aletas* (without winglets, meaning gills); when I searched for them on land, on the bordering meadows, under stones, or amongst the trees, the people laughed at my ignorance of expecting to find "fishes" on dry land. There are no fishes in that stream. But this, their "fish," they pronounced as no good, because these axolotes de cerro (Mountain Axolotl) are not eaten like the "axolotes del lago."

During our last visit the mountain-streams were transformed into turbid roaring torrents, and it was only at a few spots that the Newts were visible, generally in some stiller water, in the shelter of some great boulder. There they stood, or rather were lying, on little patches of sandy bottom, the larvæ working their gills vigorously, the adult motionless except for the undulating tail, and never rising to the surface to breathe. They were all extremely shy, quickly hiding beneath or between the stones.

In the Montes de las Cruzes, close to the railway-station Dos Rios, the streams form here and there little swamps or ditches, with much watercress in the slowly-flowing water; there we found plenty of larvæ; the adult only in the running water. Not one of these mountain-streams runs dry.

The lungs are well developed.

The only specimen, a larva 100 mm. long, which I succeeded in bringing home alive in 1902, metamorphosed within 8 weeks, losing the fins and gills, and closing the gill-openings completely, but it died before losing the yellow and black piebald coloration.

The distribution of *Amblystoma* in Mexico coincides absolutely with the large central and western portion of the country, which has been covered with volcanic masses, repeatedly or successively, since the Eocene epoch; and the last outburst, which produced the Pedregal near Mexico, is known to have occurred after this part of the country was already inhabited by man. It was impossible for Amphibia to live on such a terrain until it was weathered enough to sustain a permanent and moisture-loving vegetation. In fact every locality where *A. tigrinum* is known to occur is on the Quaternary, mostly sandy, patches formed by the disintegrating debris of the volcanic masses; or it is found in the lakes, all of which are partially filled-up mountain valleys.

We have to conclude that the Amblystomas are recent immigrants from the North. Where they have met such lakes,

these have become, or are becoming, too attractive for them, with the result that *A. tigrinum* has sunk, or is sinking, into a more or less perennibranchiate state, the Axolotl. Typical Axolotl are those of Lake Xochimilco, the condition of which I have described in 'Nature,' Feb. 5, 1903, and Lake Patzcuaro, which, with its rushes, weeds, and other abundance of vegetation, is very similar to the Mexican lake. Sexually ripe Axolotl are also known from Jalisco mountain tarns or lakes, and lastly from St. Mary's Lake, Estes Park, Colorado. It is therefore the combination of certain favourable circumstances (permanence of water, abundance of food, shelter, equable temperature) which produces the "Axolotl." Whoever has seen the very different conditions prevailing in Lake Zumpango, to the north of Mexico City, will easily credit Velasco's statement that *A. tigrinum* metamorphoses into the normal gill-less Newt, as it does in the United States, and probably in various other parts of Mexico.

All the more interesting is the fact that the other species, *A. altamirani*, the only one which lives in the streams of recent volcanic mountains, has been modified into a gill-less but permanently aquatic form.

DESMOGNATHINÆ.—The three species of *Desmognathus* inhabit the Eastern United States.

Typhlotriton spelæus is restricted to subterranean caves in Missouri. *Thorius pennatulus*, the only remaining member of this small group, and its sole representative in Mexico, points therefore unmistakably to the Eastern half of North America as the original home of the group, not of *Thorius* itself.

This tiny Newt, less than two inches in length and thinner than a match, with weak limbs and reduced digits, shows a peculiar dimorphism of the size of the nostrils. They are very large and open in the males, much smaller in the females. The lungs are quite aborted as in *Desmognathus* and *Spelerpes*.

Thorius has a very limited distribution. It was discovered on the south-western slope of the Pic of Orizaba. I found *Thorius* in abundance on the south slope, 9000–10,000 feet, in high, mixed forest, either on the ground beneath flat pieces of fallen bark, or on decaying logs of pine between the bark and the wood amongst the "worm-meal" of boring beetles and maggots. Again I met them under exactly the same conditions on the Cerro de San Felipe, 8250 feet, near Oaxaca. These are the only two localities so far as we know at present. It is doubtful whether their distribution is now continuous; the watershed between the Atlantic and Pacific, to the west of a line drawn from Orizaba to Oaxaca, averages about 8000 feet in height, and it is well-wooded, but there are several deep transverse depressions in it.

PLETHODONTINÆ.—This group, consisting of 5 genera with about 40 species, is entirely American, with the sole exception of *Spelerpes fuscus* in Europe.

Spelerpes.—This large genus, composed of about 20 species, ranges from Massachusetts into North-western South America. At least 10 species live in Mexico, 9 of them south of a line drawn from Guadalajara to Tuxpan on the Atlantic; some of them extend into Guatemala and Costa Rica. *S. yucatanicus* in Yucatan. A few occur as far south as Peru; one, *S. infuscatus*, inhabits Hayti, and *S. fuscus* lives in Sardinia and Northern Italy.

The distribution of the Mexican species is important. The Aztec name is "Tlaconéte" = little land creature.

S. cephalicus, described by Cope from "North-eastern Mexico." No *Spelerpes* seem to occur in Texas; the nearest American species, *S. multiplicatus*, lives in Arkansas; *S. orizabensis* and *S. lineolus*, the latter with tiny, reduced limbs, are known only from the mountain of Orizaba, *S. orizabensis* ranging between 8000 to 12,000 feet.

S. leprosus, of which *gibbicaudus* Blatchley is a not unfrequent individual variation, is common in the mixed and pine forests of the mountain of Orizaba, up to 12,000 feet. It has also been recorded from the north slope of Popocatepetl, 9000 feet, and from the mountains of Jalapa.

S. morio from "Jalapa," and from Tlalpam, which lies between Mexico City and Lake Xochimilco, in flat, sandy, moist terrain, with meadows and willows. It appears again far in the south, in Guatemala and Costa Rica.

S. chiropterus. Mountain of Orizaba, from the town, 4000 feet up to near 10,000 feet; "Jalapa," and Cuernavaca which has an elevation of 5000 feet. "Vera Cruz" must be left as a doubtful locality.

S. rufescens is recorded from "Orizaba," Cordoba, Vera Cruz, Tehuantepec, Chiapas, and Tabasco; all in the Tierra Caliente, except the first locality.

S. variegatus ranges from the Valley of Mexico, Orizaba (from 9000 feet downwards), Jalapa, Cordoba, right through the forest of the Tierra Caliente and through the whole of Central America tc Costa Rica. I found it on Orizaba mountain, as well as at San Juan Evangelista, which lies scarcely higher than 100 feet above the sea, in the same ground with *Dermophis.*

S. uniformis, with reduced limbs like *S. lineolus*, described from Costa Rica, elevation of 5000 feet, is said also to have come from "Vera Cruz."

Lastly, *S. belli*: mountains of Jalapa, Orizaba, Mexico, Zacualtipan, Guanajuato, Guadalajara, Sierra de Nayarit; and at Omilteme, west of Chilpancingo. This species alone has found its way across the plateau, following the belt of alluvial deposits described elsewhere (p. 237). With the exception of this transverse belt, the distribution of Mexican Newts coincides closely with the broad band of Cretaceous limestone which extends from Nuevo Leon to the Isthmus, with intricate but almost continuous patches verging from Cordoba and Orizaba south-westwards to Chilpancingo. This limestone terrain was the only one available

for Newts during most of the Tertiary period: on the west the plateau suffering from the volcanic revolutions; on the east the sea still covering the present Atlantic Tierra Caliente. The Cretaceous parts formed so many oases where alone Newts could exist or survive. Later, when the volcanic ranges, even the volcanoes themselves, became covered with forests, the Newts spread onto them, just as they have spread into the moist hot-lands of the State of Vera Cruz. It may appear strange that the limestone should have been the means of their preservation, considering that lime-water is, as a rule, not favourable to their development; but here comes in the significant fact that most, if not all, the Mexican *Spelerpes* are viviparous, unless they deposit their eggs, like *Batrachoseps*, in hollow trees. Some of them, for instance *S. orizabensis*, lead a partially arboreal life. We found many on the pine-trees of Citlaltepetl, favourite hunting and hiding places being the epiphytic plants, especially the large Tillandsias, Orchids, and Philodendron in the hot country forests. The humus and moisture collecting in these growths, often many feet above the ground, swarm with insect life and with little Scolopendras, which seem to be the staple food of these *Spelerpes*.

The apparent absence of Newts on the Northern plateau is most likely due to the dearth of permanent moisture, long-continued periods of drought, and dust. A more difficult question is the apparent absence of Newts on the terrain of gneiss and granite which covers so large a portion of Southern Guerrero and Oaxaca, and on the well-wooded mountains of the Sierra Madre. For months have we searched Guerrero during the rainy season (there are thousands of places which, if they were on the Eastern slope, would yield an abundance of Newts), but it was in vain. A few specimens of *S. belli*, from the mountain forest of Omilteme, are the only exception.

Batrachoseps.—*B. scutatus* ranges from Illinois to Rhode Island and to the Gulf of Mexico; the other species live in the Pacific States, from California to Oregon. Quite unexpected was therefore the occurrence of the Californian *B. attenuatus* on the Nevado de Colima. I found a single, young specimen on the northern slope, at about 7000 feet elevation, in the stump of a decayed pine-tree. There are some patches of granite and of limestone in that district, but then comes an unbroken stretch of originally volcanic formation, for about 200 miles, until the gneiss is reached to the north-east of Mazatlan. We cannot well imagine that this species is an ancient survival; it must be a comparatively recent immigrant from the north-west, from California. Probably it occurs all through the slopes of the western Sierra Madre, which is mostly clad with pine-forests.

Résumé of the Distribution of Mexican Urodela.

All the American Urodela are of Nearctic origin, with their earliest centre in Old Sonoraland. At least the Amblysto-

matinæ point to the long-continued land-connection with Eastern Asia. A later centre of dispersal lies in the Eastern half of North America, the old Appalachia, the Alleghany mountains, &c., whence Urodeles have spread, as Plethodontinæ and Desmognathinæ, over most of the Eastern and Southern States, also into and through Mexico's eastern half. This spreading dates back to Miocene times, witness the existence of *Spelerpes* in Hayti, while others have reached even South America, and, lastly, the occurrence of a *Plethodon* somewhere in the La Plata basin. Much later immigrants, directly from the old north-western home, are *Amblystoma* and *Batrachoseps*: *A. tigrinum* and *B. attenuatus* being identical species in the States and in Mexico, only *A. altamirani* being a new modification; while *Spelerpes* has developed many species, different in the north, centre, south, and in Hayti.

ANURA.

PELOBATIDÆ.—*Scaphiopus*, the Spadefoot, closely allied to the European *Pelobates*, is the only American genus of this family, with about 7 or 8 species, two of which are restricted to the United States. The zone of sandy terrain of Texas, New Mexico, and California is richest in Spadefeet, whence they have extended over the Mexican plateau down to the Pacific and Atlantic coasts. *S. dugesi* s. *hammondi* has the widest distribution: from Missouri and California through New Mexico and Texas, the mountains west of Chihuahua, in Guanajuato, and again on the southern slope of Oaxaca, where I found it at Totolapan, its most southern locality. The retiring habits of the Spadefoot no doubt account for the few scattered records. The well-wooded mountain-ranges which form the south-eastern, southern, and western borders of the Mexican plateau are a natural obstacle to a further southward spreading of this genus.

BUFONIDÆ.—Central America and Mexico are one of the centres of Bufonidæ. Concerning Mexicans, they can be grouped as follows:—

1. Indigenous: *Rhinophryne dorsalis*, the only species of the genus, a toad specialised as an eater of Termites; it is restricted to the moist Atlantic Tierra Caliente, from Tuxpan, north of Vera Cruz, through the Isthmus to Campeche and Guatemala. The light-coloured spots on the bluish-slaty black skin are either yellow or orange to red, varying in individuals from the same locality. They are very sluggish, rather nocturnal, and retire beneath a rotten stump or into a small self-dug hole in the moist humus. Aztec name "Póche."

2. Southerners: *Engystomops*, the few species of which range from Venezuela and Ecuador northwards, but only *E. pustulosus* reaches the Isthmus of Tehuantepec.

Several of the 13 species of *Bufo* found in Mexico are southern forms: in their spread northwards they either stop short at the

Isthmus, *B. coccifer* and *B. sternosignatus*; or they extend into the Atlantic hot-lands, *canaliferus*; or along the Western Sierra Madre into Jalisco, *intermedius*, with *marmoreus* peculiar to South-western Mexico; or they go as typical hot-country Toads into both the eastern and western Tierra Caliente, *marinus*, *valliceps* on the Atlantic side from Nicaragua to Texas, not on the plateau, but recorded from Jalisco and Presidio near Mazatlan; lastly, *B. simus* from Panama on to and over most of the Mexican plateau.

3. Northerners, chiefly at home in the South-western United States and in the northern half of Mexico, eventuallly extending south over the Central plateau: *B. punctatus*, *debilis*, *compactilis*.

Of the Bufonidæ which are found in the Greater Antilles all are now separate, insular species, except *B. marinus*, which has probably been introduced.

Hylidæ.—The creative centre of this family is decidedly South America. Every one of the 14 genera of Hylidæ is found in America, and it is only by the large genus *Hyla* (incl. the slightly modified *Hylella*) that this family has attained its world-wide range with the remarkable exception of the whole Palæo-tropical region. From North-western South America they have spread through Central America into the Antilles (about 7 or 8 species, mostly peculiar), and through Mexico into North America.

Concerning Mexico they fall into the following groups:—

1. Genera peculiar to Mexico: *Pternohyla*, *P. fodiens* of Presidio near Mazatlan; *Triprion*, *T. petasatus* of Yucatan; but *Diaglena jordani* of Ecuador and *Corythomantis greeningi* of Brazil point to the south as the old centre of these peculiar Mexicans.

2. Genera with preponderating numbers of species in Central and South America, while comparatively few have reached, or have been developed in, Mexico: *Phyllomedusa* with only *P. dacnicolor* on the Pacific side, *Agalychnis callidryas* and *Nototrema oviferum* in the Atlantic Tierra Caliente.

P. dacnicolor is saturated green, often with the same white temporary patches or spots as happen so frequently in the Australian *Hyla cœrulea*. They were pairing at Rio Balsas in the month of June. During the nightly thunderstorms the males kept up an incessant noise like the snarling bark of little dogs. The couples were sitting in low shrubs or amongst herbs, a foot above the ground, overhanging little ditches which led into a dirty stagnant pool. During the daytime the ditches were absolutely dry. The eggs are very small, very numerous, and of a light grass-green colour.

3. *Hyla*. About 15 species are recorded from Mexico, to which no less than 11 seem to be peculiar, but at least 8 of these have hitherto been found in single localities only. Our knowledge of the distribution of Tree-frogs is still very defective. Most of them inhabit the forest-regions of the Atlantic slope. They are dis-

covered and caught by mere accident. For instance, I found one single specimen of *H. staufferi* at Motzorongo, a species until then known only from Guatemala. *H. boucourti* of the same country has been recorded once from Tepic, none from the enormous intervening stretch. *H. miotympanum* seems to range from the Isthmus through the mountainous parts of Vera Cruz, going up towards Puebla. *H. venulosa* is an eastern form, from South America to Tampico, decidedly Atlantic, but once recorded from near Mazatlan. *H. baudini*, the commonest Tree-frog, ranges from Ecuador right through Central America, and then spreads east and west through the hot countries of Mexico, absolutely avoiding the plateau, but reaching Texas.

On July 4, 1902, when the rains were very irregular, we found *H. baudini* spawning, south of Cordoba. On a piece of inundated woodland meadow, about the size of a suburban lawn, were 45,000 frogs at a low computation, two-thirds of them in amplexus, the other males making a deafening din. Next day the pool was dried up completely, the grass glazed with the spawn, and there was not a single frog to be heard or seen in the neighbourhood.

H. copei, known as "Sapo blanco" or white toad, is a hill form. Known already from Texas, Chihuahua, Guanajuato, and Jalisco, I found it plentiful on the whitish calcareous terrain south of Chilpancingo, not in the trees but sometimes on rather barren and dry fields. Decidedly typical of the western and southern plateau and its Pacific slope, and very abundant, is *H. eximia*.

Result.—Mexico has many Hylidæ in common with Central and even South America; but the majority are now peculiar to Mexico, and only two, *H. copei* and *H. baudini*, extend northwards into Texas.

Cystignathidæ, like the Hylidæ, of decidedly South-American origin. Of the 15 or 16 genera of this family only *Leptodactylus* *, *Paludicola*, *Syrrhopus*, *Hylodes* *, and *Borborocœtes* occur also in Mexico, altogether with some 23 species. Those marked * are also Antillean. Not one reaches the United States; in fact the most northern record is made by *H. calcitrans* at Zacatecas. *B. mexicanus* is peculiar to the Central plateau and the high mountains of Jalisco, Colima, and Guerrero. Of the 9 or 10 species of *Hylodes* 6 are restricted to Mexico, but their recorded localities are still too few and scattered. The same applies to the six species of *Syrrhopus*; the others range far south to Nicaragua and Costa Rica: *H. palmatus* is Pacific, *H. melanostictus* Atlantic Mexican; *H. rhodopis* on either side. The last is the commonest species and seems to be an instance of a southerner which, although not going on to the plateau itself, ascends the high mountains on its eastern, southern, and western borders, *e. g.* Citlaltepetl up to 10,000 feet, Cerro de Oaxaca, Nevado de Colima; it also inhabits the hot lowlands of Agua fria in the State of Vera Cruz. Mostly of dark brown and reddish tints and living on or near the ground; however, some specimens in the epiphytic Tillandsias, or on green

shrubs at the edge of a forest, were quite green, but they soon changed to reddish yellow and ultimately assumed the normal reddish colour.

Of the 5 species of *Leptodactylus*, 3 are too little known. *L. microtis* from "Guanajuato" would be the only instance of the occurrence of a *Leptodactylus* on the plateau instead of in the lowlands. Only two species have a wide distribution: *L. albilabris* of South Guerrero, Oaxaca, and of Vera Cruz, also Antillean; *L. caliginosus* from Paraguay northwards, in Mexico in the Pacific Tierra Caliente as far as Mazatlan.

ENGYSTOMATIDÆ, with an obviously South-American centre of dispersal; not Antillean. The small genus *Engystoma* reaches through Mexico into the South-eastern United States (*E. ustum*).

RANIDÆ.—This family is essentially Palæo-tropical. Scarcely more than a dozen species, all belonging to *Rana*, occur in North America, only 6 in Mexico, and fewer still further south, in the north-western portion of South America. There, however, the Ranidæ have found a new congenial home, which has stimulated them into the development of 5 new genera, with about one dozen species, all arboreal, besides *Dendrobates*. The Ranidæ have not found their way into the Antilles.

Of the six Mexican species, *R. forreri* is restricted to the district between Durango and Mazatlan; *R. pustulosa* to same district and Western Jalisco; *R. omiltemana* to Guerrero mountains: these three are peculiar to Mexico. *R. halecina* is the common river-frog of the country, both in the hot parts and on the plateau, extending from the United States through the whole of Mexico down to Costa Rica. *R palmipes* ranges from southern tropical Mexico to South America. Lastly, *R. montezumæ*, the largest of all, is a lake-dweller, *e. g.* lakes of Jalisco, near Mexico City, Tehuantepec, extending south into Tabasco and Guatemala.

Résumé of the Distribution of Mexican Anura.

We can easily distinguish between northern and southern immigrants.

1. Northern, decidedly of Nearctic origin. *Scaphiopus*, scarcely reaching the Isthmus of Tehuantepec; and a few *Rana*, all water-frogs. Both genera are comparatively recent immigrants, non-Antillean, although *Rana* extends through and beyond Central America.

2. Southern, of obvious South-American origin.—*a.* With related, or identical, species in the Greater Antilles. *Cystignathidæ*, not reaching the United States. *Hylidæ* and *Bufonidæ*, each, especially the Hylidæ, with genera peculiar to Mexico, indicating ancient residence.—*b.* Non-Antillean, a few *Engystomatinæ*, scattered through Mexico.

Crocodilia.

Crocodilus americanus is the commonest tropical American Crocodile, from Florida to Northern South America. In Mexico it is strictly confined to the Tierra Caliente, with Mazatlan as its north-western limit. It ascends the Rio Balsas at least up to Mescala, but this is not much more than 1700 feet above sea-level. Common in the lagoons on the coast of Guerrero and Oaxaca, except where it has recently been well-nigh exterminated by American skin-hunters. More exist in the river-systems of the State of Vera Cruz, ascending occasionally up to Motzorongo, *i. e.* 1500 feet. During the rainy season they often forsake the then turbid rivers, and roam at night through the forests in search of lagoons.

C. moreleti inhabits the Tierra Caliente from Tampico to Honduras.

Caiman sclerops s. *punctulatus* has its centre in South America. In America it occurs only in the Atlantic hot-lands. I met with very large specimens (length of skull 20 inches) at Agua fria in the same lagoons and rivers as the Crocodile. Whilst the latter, anyhow not averse to brackish water, inhabits the Greater Antilles, the Caiman has found its way only into Trinidad and, if report is true, to Martinique. The Alligator of the southern United States does not seem to cross the Rio Grande.

Chelonia.

It seems almost incredible that *Chelydra* has never been recorded from Mexico, considering the wide range of *Ch. serpentina* in the United States and the existence of the other species, *Ch. rossignoni*, from Guatemala to Ecuador. The Papaloapan and S. Juan Rivers of the State of Vera Cruz are certainly large enough, with pools and backwaters, but I could not ascertain the presence of a large, snappy species.

Dermatemydidæ.—The few species of this family are peculiar to Central America. *Dermatemys mawi* extends from Honduras into Yucatan and Vera Cruz; it occurs, for instance, in the pools of the forests and savannahs near Tetela, where it is known as the "Tortuga blanca." *Staurotypus* seems to have a similar range: *S. triporcatus* going up to Vera Cruz; *S. biporcatus* only up to the Isthmus.

Cinosternidæ, with the sole genus *Cinosternum*. About 10 species in North and Central America, one extending to Guiana. Well represented in Mexico by 6 species. Of these, *C. pennsylvanicum*, previously recorded from the Valley of Mexico, was found by myself in South Guerrero, at San Luis Allende. *C. hirtipes* ranges from Arizona and New Mexico along the Pacific side into Jalisco, and includes the Tres Marias Islands.

C. sonoriense in Sonora. *C. integrum* (a variety of *C. scorpioides*) is likewise Pacific, from Jalisco, *e. g.* Lake Chapala, to which I can now add Zapotlan and the small rivers on the plateau south of Oaxaca and the swamps of San Mateo near Tehuantepec. *C. leucostomum* extends from New Orleans along the Atlantic side of Mexico through and beyond Central America. *C. effeldti* is known from the State of Vera Cruz, San Mateo del Mar, and Guatemala.

TESTUDINIDÆ.—*Cistudo* with two species in North America and one in Yucatan, strictly terrestrial. *C. mexicana* of Texas and New Mexico, *e. g.* San Marcial. How far it extends into Mexico is not known; Tampico is quite possible, but I very much doubt "Mexico City" and neighbourhood.

Nicoria rutila I have met in swampy bush-land of the State of Vera Cruz and near Tehuantepec, and this seems to be its range; allied species occur in Central America.

Chrysemys extends from Canada to Argentina, but with a preponderance of northern forms. In Mexico restricted to the hot countries, and even there common only about the Isthmus, whence *C. grayi = umbra* and *C. incisa* go further south. *C. ornata*, from Panama to Tehuantepec, has been found by Forrer also near Mazatlan, with *C. pulcherrima*. I do not know of a single locality for *Chrysemys* on the plateau, or to the east of it, except for *C. mobiliensis*, which goes from Texas into the lowland of Nuevo Leon.

This scarcity of Water-Tortoises in Mexico is rather puzzling. On the plateau *Cinosternum* alone is found, and these thick-shelled box-like creatures are, moreover, the only kind which can withstand the buffeting to which they are subjected in the torrents into which the rivers of the slopes of the plateau are converted in the rainy season. The Tortoises hide then under the boulders in the stream. *Chrysemys* shuns such waters, and neither it nor *Cinosternum* occurs in those rivers which carry much sand.

Chelone viridis was laying during July and August on the coast of Guerrero and Oaxaca.

Résumé of the Distribution of Mexican Chelonia.

The Cinosternidæ, taken with the closely-allied Dermatemydidæ and Chelydridæ, are autochthonous Americans; the first a Sonoran, the second obviously a southern group so far as the present distribution is concerned. Both Chelydrids and Dermatemyds are known from the Cretaceous of North America. The three together may well be regarded as originally northern and ancient. The same applies to the Testudinidæ, the only family which has, recently, sent a United States *Chrysemys* into the Antilles and a South American into the Windward Islands. The Testudinidæ, plentiful in North America, scarce in Central, and with still fewer species in South America, have clearly come from the

Northern continent. The earliest, probably all of the genus *Testudo*, have been found in the mid-Eocene of Wyoming and New Mexico; since Oligocene in Europe, still later in India. With this remote occurrence in ancient Sonoraland I couple the most important fact of the Galapagos Tortoises. They are a strong indication of the former, let us say Oligocene, extension of land considerably to the west and south of the present Central America. We shall find this idea supported by Iguanidæ. Now North America possesses but the single *T. polyphemus* in the South-eastern States, and South America has only *T. tabulata*. Something has gone wrong with this genus, which has flourished in the Miocene of Dakota, Nebraska, and Oregon, as has been the case with so many mammals which started and flourished in the States and are now restricted to the Old World.

Lacertilia.

Geckonidæ.—The distribution of American Geckos is almost entirely tropical. The greatest number and diversity of species occur in the Antilles, in Northern South America and the adjoining Central America, whence few have spread into the warmer parts of Mexico, avoiding the plateau. North America has received only *Sphærodactylus notatus* from the Antilles through the Bahamas into Florida, and *Phyllodactylus tuberculosus* into California; this species is the commonest Gecko in Mexico, ranging strictly along the Pacific slope to the Isthmus of Tehuantepec and thence to Nicaragua. *Sphærodactylus* sends only three species into Mexico: *S. glaucus* to Salina Cruz and into the State of Vera Cruz; the Central American *S. torquatus* and the Antillean *S. anthracinus* are recorded from the same State, and *S. torquatus* has been described from Mazatlan. *Gymnodactylus sumichrasti* reaches the Isthmus, and *Thecadactylus rapicauda*, of Yucatan, Antilles, and southwards, is said by Cope to have been recorded from Guadalajara, a very doubtful locality.

Phyllodactylus tuberculosus is common in the villages of Southern Oaxaca and Guerrero, where it is known as "Pata de bueye," *i. e.* ox-foot, because of its peculiar digits. The general name for Geckos is "Salamanqueza" or "Salamanquezca," which name, however, also applies to the slippery *Mabuia* and *Eumeces*. I found the same Gecko on the trees of dense forests near the coast of Guerrero. *Sphærodactylus glaucus* is typically xerophile. As in Spain and Portugal, all Geckos are considered extremely poisonous.

Eublepharidæ.—This small and very scattered family (in West Africa, Somaliland, India, Transcaspia, and Persia) is represented by three species in Mexico, a few others occurring in Panama and Ecuador. *Eublepharis variegatus* is the northern offshoot, from El Paso to the Gila River and California, probably also in Sinaloa. *E. fasciatus* is known from Ventanas, north-west of Mazatlan. These are apparently typically xerophile, like the

two Asiatics of the same genus. But *Coleonyx elegans* is distinctly a forest form. I found it a few miles from the coast of Guerrero in a moist patch of thick lowland forest on the ground under stones and rotten stumps. A typical Central American, ranging through the Pacific and Atlantic Tierra Caliente of Mexico, from which country it had hitherto been recorded only by Sumichrast from near Orizaba; extending south to Costa Rica.

IGUANIDÆ †.—It is not profitable to speculate upon the original home of this family. The overwhelming majority of genera and species is American, from Mexico to Brazil. It is well known that the Galapagos possess the semimarine *Amblyrhynchus* and *Conolophus*, that a few species occur in Madagascar, and *Brachylophus fasciatus* in the Viti and Tonga Islands; further, that an Iguanid allied to the genus *Iguana* existed in the Eocene or Oligocene of Europe, and that therefore attempts have been made to explain the present scattered distribution of the family by a formerly subuniversal range; in other words, they are a very ancient group.

Concerning America, it is significant that only a few species of *Sceloporus* and *Phrynosoma* extend into the United States, although far northwards. Of the large genus *Anolis*, only *A. carolinensis* enters Texas to Carolina, but it is also found in Cuba.

Mexico itself, Central America, and the Antilles are rich in genera and species. These Iguanidæ can be divided into two groups:—

A Sonoran set, comprising genera which are essentially xerophile and humivagous, with depressed bodies and short tails. None of these reaches far into Central America, and none has entered the Antilles. *Crotaphytus*, *Holbrookia*, *Uta*, *Phrynosoma*, *Sceloporus*, which, in the order mentioned, extend from California and Arizona southwards, with decidedly Pacific or Western predilection; only a few *Sceloporus*, those which have spread into the Atlantic Tierra Caliente, continue further into Central America. Nearly all these southern *Sceloporus* are fitted for arboreal life, less depressed in body, and suited to a moist climate, be this hot or cool. They lead thereby to the second set, which are essentially arboreal, mostly inhabitants of forests or of rocky bush-land; all southerners, with their centre in Central and South America, extending into the Mexican Tierra Caliente, with prevalence on the Atlantic side, and two * have allied genera or species in the Antilles: *Anolis* *, *Iguana* *, *Basiliscus*, *Læmanctus*, *Corythophanes*, and *Ctenosaura*.

Of course there are transitional forms, for instance the genus

† Iguana, or Guana, is a native word applied to the Iguana; but where this does not occur, the name is given to *Ctenosaura*, for instance at Cuernavaca. The Zapotec name of *Ctenosaura* is Tilcampo; *Basiliscus* and *Corythophanes* are called Teteréte. At Rio Balsas, scaly lizards, e. g. *Sceloporus*, are distinguished as Chintéta.

Ctenosaura, and we will not discuss the question which of the two groups is the more primitive; apparently the latter, but this can be contested.

Crotaphytus, a typical old Northern Sonoran genus with several species in Western United States. *C. wislizeni* ranging from Oregon and Nevada into Sonora and Chihuahua; *C. collaris* also into Nuevo Leon.

Holbrookia, from Texas and California into the dry parts of Northern Mexico. *H. maculata* into North Sonora, *H. texana* to Monterey and Lerdo near Torreon. I found it running about swiftly on the almost barren shaly ground near El Paso. *H. propinqua* from Texas to Presidio near Mazatlan.

Uta, with most species in South-western United States and in Lower California. *U. elegans* from Utah to Texas and Sonora; *U. stansburiana* from Utah to Torreon. *U. lateralis* from Presidio and Tres Marias Islands and *U. bicarinata* are Mexican, from Presidio to Tehuantepec, and everywhere between these places. Otherwise strictly confined to the western side of the plateau and the coast, it has entered the plateau at Cuernavaca and Puebla. I have almost invariably found it on the stems and branches of low trees, upon which they flatten themselves like arboreal *Sceloporus*; rather remarkable, since the other species are so decidedly dwellers on the sandy or stony ground. Very important is the occurrence of a species, *U. auriculata*, on the Revilla Gigedo Islands, 280 miles south of Cape Lucas, Lower California, and nearly 350 miles from the coast of Jalisco. This genus is typically Sonoran, with its centre around the Gulf of California.

Phrynosoma, "Animal rey," or "Camaleón," or "Escorpión." The original centre of this genus is undoubtedly Sonoraland, whence it extends now over most of the Central, South-western, and Western States of North America and over the whole of Mexico as far as Guatemala. *Ph. cornutum, modestum*, and *orbiculare* are, in Mexico, scattered over the plateau. *Ph. asio* is the most southern and at the same time the largest and most handsome species, ranging from Colima to Guatemala. Stejneger and Cope have already remarked on the "metachrosis" of *Ph. douglasi*. I have found *Ph. modestum* near El Paso of exactly the same delicate French-grey colour as the little slabs of Cretaceous limestone with which the hills are strewn; the same species at San Marcial and at Rincon in Mexico, on the red and sandy volcanic rubble of that hilly desert region, were of the same pronounced red tint. Examination with a magnifying-glass showed the spirit-specimens to be covered with the iron-stained red sand, but those which I have brought home alive show this same red colour also to be that of their genuine skin.

Sceloporus may well be called the most characteristic genus of Mexican Lizards. Of the 34 species recognised by Boulenger, 28 occur in Mexico, between El Paso and Tehuantepec. Only 4 live in the United States, and only 3 or 4 are found south of

the Isthmus of Tehuantepec, and are restricted to Central America.

Some species have a very wide, others a very limited distribution. The majority combine humivagous with climbing habits, and show great adaptiveness to the nature of their surroundings; for instance, *S. scalaris* and *S. æneus* do not climb the trees beneath which they live, but prefer the grassy ground, and they are equally at home in the moist, clouded pine-forests and on the more barren, grassy and lava-strewn slopes up to the snow-line. *S. variabilis* prefers the wooded lowlands of the Atlantic side, and likewise does not climb, loving the banks of rivulets and well-herbed ravines. Others, e. g. *S. torquatus*, are found only on rocks, stone walls, and buildings; they are swift. Some—and these are the most depressed in body—are rather sluggish, e.g. *S. spinosus*, and spend most of their time on the ground between spiny growth of hedges and low trees, which they ascend a little way, in short rapid jerks, when alarmed. Lastly, *S. microlepidotus* is truly arboreal, ascending the trees in the morning, with the sun, right into the green tops, where they hunt for insects. This species has the greatest possible altitudinal range; from the hot country of Southern Oaxaca, only a few hundred feet above the level of the sea, to the upper tree-line of Citlaltepetl, about 13,500 feet elevation.

Many species are viviparous. According to my own observations, the following: *acanthinus*, *æneus*, *formosus*, *microlepidotus*, *scalaris*—all gravid in the months of July to September.

Iguana rhinolophus is interesting for various reasons. It is the largest Lizard in Mexico, attaining a total length of about 5 feet. Always arboreal and aquatic and truly tropical, it occurs in the whole of Central America, but in Mexico, north of the Isthmus, only in the States of Vera Cruz and Southern Oaxaca, everywhere strictly below the Plateau, and on the Pacific side it has been recorded only from Manzanillo near Colima and near Mazatlan; undoubtedly also near San Blas and in the lower reaches of the Balsas, but this information I have only from hearsay. I never found it in Guerrero. The creature requires permanent, rather sluggish rivers, or deep pools in the savannahs. They climb about in the trees, eating the succulent leaves, which they bolt without much chewing, for instance those of the guava tree. Favourite places for resting are the branches which overhang the water, into which they plump with a loud splash, sinking at once and remaining at the bottom for many minutes. Whilst the adult are dusky, the young are grass-green and are frequently found in the tall grass at the edge of a pool. They at once take to the water and swim to the bottom, with their legs laid back and propelling themselves, like newts, by rapid undulating motions of the tail. The eggs are buried in the soft soil, among the roots of a tree, always near the water, in the month of May; by the end of July they are already hatched. They are known as Guanas or Iguanas.

Ctenosaura acanthura is a common Lizard of the hot and warm

countries, from Yucatan to Tampico and on the Pacific side as far as Southern California. It does not take to the water, preferring rocky bush-land or savannahs. According to the locality, it makes its home in a hollow tree, in the roof of a house, or on the ground, where, among rocks or trees, it digs out a permanent burrow, heaping up the soil above and around it. This "Iguana," or "Tilcampo" of the Zapotecs, is very fierce, bites, and lashes out furiously with its tail. Its food is varied, from all kinds of lizards, snakes, and insects to grass and flowers; in turn the Tilcampo itself is much prized as an article of food, and in the markets fetches more than two fowls.

The young are entirely vivid green; in their second and third years the back and sides develop blackish patches upon the green ground, and in this stage they are often very beautiful. With approaching maturity the green colour disappears, being encroached upon and then entirely suppressed by the spreading black and brown pigment. But in certain localities, where these lizards live amongst luscious growth of evergreen trees, many individuals retain their green livery throughout life. I caught a young Tilcampo, which belonged to a green family, as shown by the parents, at San Juan Evangelista, on the eastern side of the Isthmus, where the green colour was normal; within less than 18 months my captive had lost all the green, and had assumed the dusky brownish and patchy garb.

Ctenosaura quinquecarinata.—This much smaller, brownish-yellow species is not arboreal, ranging from Honduras into the southern hot parts of Oaxaca. It becomes very tame, takes a varied diet, and defends itself in its burrow by sideward strokes of its spiny tail, much like the Indian Uromastix, which it greatly resembles in habits and outward appearance.

Basiliscus vittatus.—Closely allied to the Central American *B. americanus*, ranges from Ecuador into the Tierra Caliente of Mexico, where it is, however, restricted to the southern part, not going further north than Cordoba. Until I found it at Tequesixtlan and Tierra Colorada in the centre of Guerrero, it was not known from the Pacific side. The locality "Orizaba" in the 'Biol. Centr.-Am.' is erroneous; Sumichrast states clearly, and correctly, that this species extends only up to 3300 feet. The "Pasarios," its universal Spanish name, lives always on the banks of rivers or pools. I generally found them busy on the ground close to the water's edge, or upon a low overhanging branch. On the slightest alarm, they plunge or rush into the water, rapidly running over the surface in a slightly erect position, splashing the water with their long-toed hind limbs and the long wriggling tail, whilst the arms are adpressed to the body. They do not dive; arrived on the other side, they climb up the bank and hide in the tangled vegetation. The usual statement that they propel themselves by rapid strokes of the fore-limbs is erroneous, and the notion that the high dorsal and caudal crests, which adorn the male only, serve as a sail is a fable.

Corythophanes hernandezi, "Teteréte."—From Chiapas and

Yucatan to the State of Vera Cruz, absolutely confined to the Atlantic Tierra Caliente, in forest-land; arboreal, or rather amongst shrub-like trees, the brown bark of which this curious-looking gentle lizard looks to for protection. It feeds upon insects.

Læmanctus.—The two Mexican species are excessively rare, perhaps because they live higher up in the trees, where it is then next to impossible to discover them. *L. serratus* is known from Campeche and the States of Vera Cruz and Oaxaca without localities. *L. longipes*, hitherto known from Jalapa only; all the more remarkable is the solitary specimen which I found amongst a collection sent to the Field Columbian Museum from the State of Colima.

Anolis, with at least a dozen species in the Eastern or Western Tierra Caliente. *A. nebulosus* has the widest range in Mexico, from Tehuantepec to Jalapa, and to Ventanas on the west; I found it not only on the coast of Guerrero, but also on the Nevado de Colima, up to at least 7600 feet, together with *A. liogaster*. *A. gadovii* at Tierra Colorada, in bush-land. The *Anolis* seem to spend most of their time on the lower branches of shrubs and trees or amongst the rank herbaceous vegetation, waiting for insects, and trusting to not being seen when basking. Especially when they have become excited by being pursued, the males stretch out their mostly beautifully-coloured gular sac. None of the Mexican species which I have observed displays any marked change of colour like the *A. carolinensis*, the "Chameleon" of the Americans.

TEJIDÆ * are clearly a Neotropical family, with several dozen genera in South America. Of all these, only *Ameiva* and the closely-allied *Cnemidophorus* extend through and beyond Central America: *Ameiva* into the Eastern and Western hot-lands of Mexico and into the Antilles; *Cnemidophorus* through Mexico into the United States, where *C. sexlineatus* has spread over nearly the whole Union. This genus is entirely terrestrial, preferring sandy districts with bush-land; only *C. guttatus* is a typical inhabitant of the lowland forests of Vera Cruz. The Mexican species avoid the high plateau, 5000 feet being about the upper limit. The only exception is made by *C. gularis*, which has been credibly recorded from Guanajuato, and of which I have examined specimens collected by Dr. Meek close to the town of Puebla, which lies at an altitude of more than 7600 feet, higher than the Valley of Mexico, where *Cnemidophorus* does not occur.

Concerning distribution and variation, *cf.* my paper, "Evolution of the Colour-pattern and Orthogenetic Variation in certain Mexican Species of Lizards, with adaptation to their surroundings," Proc. Roy. Soc. vol. lxxii. p. 109 (1903).

Ameiva undulata, the only species in Mexico, is an inhabitant

* From the Aztec "teco-ixin," *i. e.* Rock-lizard, the name of *Sceloporus torquatus*, misspelt and misapplied. The Zapotecs and Mazatecs call *Cnemidophorus* and *Ameiva* Zumbichi and Cachumbo.

of the hot, well-wooded parts of Guerrero, Oaxaca, and Vera Cruz, whence it extends far into Central America. It is far less quick than *Cnemidophorus*, and I have found it invariably in the vicinity of water.

ANGUIDÆ.—*Anguis*, with its sole species *fragilis*, and two species of *Ophisaurus* s. *Pseudopus* (Morocco to Burma) are the only members of this family which are not American, and even the third species of *Ophisaurus*, *O. ventralis*, lives in the United States. The countries now richest in Anguidæ are Mexico, Central America, and the Antilles; a few extend into South, and a few, *Gerrhonotus* with the *Ophisaurus*, into North America, where the latter is widely distributed (also recorded from Jalapa).

Diploglossus is peculiar to the mountainous regions of Mexico; *D. steindachneri* from Orizaba, Jalapa, and Guatemala. The related genus *Celestus* in Antilles and Central America.

Gerrhonotus is the main genus, eight species of which occur in Mexico, entirely in mountainous districts or on the plateau; they are consequently absent in the hot lowland forests, and references to Vera Cruz and Tehuantepec do not apply to such towns but to unknown places in the state or district.

G. cœruleus has the widest range, from British Columbia and Colorado along the Pacific side of Mexico to Costa Rica. Most of the species live on the ground, in the oak- and pine-forests, preferring clearly a moist and by no means warm climate. *G. antauges* ascends Citlaltepetl to an altitude of more than 12,000 feet, in the pine-forests, or in the grass near little streams, and higher up amongst the tussocks of grass, basking on the top of such a tussock and making its home among the roots or in the mass of last year's rotting blades. In such a place they disappear easily, although they are not quick. The same applies to *G. imbricatus*. *G. gramineus*, delicately light green above and yellow below, is arboreal, ascending the highest trees in search of insects and making its lair in hollow trees of oak, pines, and arbutus. They all are viviparous, live on insects and worms, and lose their shyness a few hours after having been caught and handled.

XENOSAURIDÆ.—*Xenosaurus grandis* alone is recorded only from the mountains near Orizaba, Cordoba, and Oaxaca.

HELODERMATIDÆ.—The sole genus *Heloderma*, unless we include *Lanthanotus* of Borneo. *H. suspectum* of Arizona and New Mexico, and *H. horridum* of Mexico. The notion that *Heloderma* is a dweller on arid mountains is quite erroneous. It is restricted to hot lowlands with sandy ground. Most of Arizona is high and dry tableland, and there is quite a trade in "Gila monsters," but, so far as I could find out, they all came from such terribly hot and low sandy places as Yuma, on the lower reaches of the Gila river, and from similar localities in Sonora. *H. horridum* is

stated by Günther to have probably a wide distribution in Mexico. The fact is that it has hitherto been recorded only from the following localities:—near Tehuantepec, and near Presidio by Forrer; and in the museum at Mexico is a specimen from Apatzingan in Michoacan. It is very local. In Guerrero and Oaxaca, Colima and Jalisco everybody speaks of the "Escorpión." "He is unkillable unless you crush him with a big stone. When at last secured in a cleft stick, his poison dropping to the ground causes all vegetation to wither for yards around. There are two kinds in Guerrero, one brown, the other black and yellow; nocturnal, hidden in the daytime beneath the stump of a tree or under a boulder; æstivating during the dry season." Hundreds of times have I offered much money, even for being taken to its lair, but all in vain. The only place where I personally know it to occur is Juchitan, not far to the north-east of Tehuantepec; in the museum at Oaxaca is a stuffed specimen, a monster about 2½ feet in length. At last I thought I had run the beast down, when at Zapotlan in Jalisco. The poison, the sluggish fierceness, difficulty in killing it, all this sounded favourable. We found the Escorpión, but it was the harmless, gentle *Gerrhonotus*, which for some unaccountable reason is feared as very poisonous! The Zapotecan name of *Heloderma* is "Talachini"; the Aztecs called it "Acaltetepon." Hernandez states that "it is found in Cuernavaca and other hot districts." But it does not occur anywhere near the State of Morelos, unless the huge figure of a lizard carved out of a rock near Cuernavaca is evidence!

The last three families taken together form a very ancient group, which seems to have its original centre in the old Sonoraland, or let us say in the old Sonoran + Central American + Antillean landmass. The absence of Anguidæ in Eastern Asia suggests the spread from North America into Europe and Asia across the polar region, unless we prefer the problematic bridge across the Northern Atlantic from the Antilles (which possess their own genus *Celestus* with several species) towards the Mediterranean.

SCINCIDÆ.—Of this large and almost cosmopolitan family America possesses the smallest number, and it is significant that the number of forms decreases from North to South. Mexico has about 10 species. They may perhaps be divided into a Northern lot, *Eumeces*, which ranges from the middle of North America over the Mexican plateau and its bordering mountains; and into a Southern set, *Mabuia* and *Lygosoma* s. *Mocoa*, which love the hot country, extending far into tropical South America, with species in the Antilles, in Mexico restricted to the Southern States east and west.

Mabuia agilis is fond of basking on shrubs and it even climbs trees, hiding under the bark. Like *Lygosoma laterale* it hunts in the dusk. *Eumeces*, of which I have observed only *lynxe* and *fuscirostris*, prefer mountain forests, where they live on the

ground, basking on the fallen leaves, between which, and in the soft humus, they wriggle away with perplexing agility.

ANELYTROPSIDÆ, an artificial assembly of a few degraded Scincoids in Madagascar, Tropical Africa, and *Anelytropsis papillosus* in Mexico. Of this only the two type specimens, described by Cope, "from near Jalapa," were known, until I found another in the humus of a dense forest near Motzorongo, south of Cordoba.

XANTUSIIDÆ.—The range of *Xantusia* extends from the desert tracts of Nevada, California with its impressive Mojave desert, into Lower California. There is little doubt that some species of *Xantusia* will be found in the desert-like country between Chihuahua and New Mexico, which has all the characteristic features of the home of *Xantusia*, not the least being the Yucca-trees, the bunches of spiky leaves of which give them shelter. The only other Mexican, *Lepidophyma flavomaculatum*, ranges from Panama to the Isthmus of Tehuantepec. The few other members of the family are likewise Central American, and one is found in the Antilles. This little strictly American family shows consequently division into a Northern or Sonoran, and a Southern or Central American Antillean group.

ANIELLIDÆ, with *Aniella pulchra* in California, and *A. texana*, of which the only specimen known came from El Paso.

AMPHISBÆNIDÆ.—The distribution of numerous Amphisbænidæ throughout Africa and several Mediterranean countries, as well as in South and Central America, Mexico, Lower California, Florida, and the Greater Antilles, seems to favour a former transatlantic connection.

Curiously enough, Mexico possesses only one genus, but this is the most interesting of all:—

Chirotes.—Discovered many years ago somewhere in Mexico, *Chirotes* s. *Bipes canaliculatus* remained almost mythical. Then Dugès received a single specimen from near Tecpan in Southern Guerrero, which he named *Hemichirotes tridactylus*. Next, some twenty years ago, the creature was discovered in Lower California in considerable numbers, they are Cope's *Euchirotes biporus*. I myself found *Chirotes* at last on the banks of the Balsas River, in the centre of Guerrero. It lives there in the fields of alluvial sand, well out of reach of possible floods. Our only chance of getting these pink, worm-like creatures was the offering of rewards to the Indians who were ploughing the fields of young Indian corn in the month of July. They live at a depth of at least one foot, burrowing little tunnels which lead a long way in any direction in the moist sand, but in the drier parts collapse at once behind the digging animal. When kept in a tin with sand, they dug into it with their heads first and then with their mole-like hands. They never appeared on the surface. Like

the Portuguese *Blanus cinereus* they soon became flabby from evaporation, but they soon swelled up again when the sand was moistened.

To split these creatures into three genera is ridiculous. But it is very interesting that the specimens from the only three localities known differ in the number of femoral pores, the length of the tail, and in the reduction of the number of the fingers and claws.

C. canaliculatus.—Fifth finger very small, clawless; three pores on either side in front of the enlarged preanal scales; tail twice as long as the head. Nasal plates widely separated.

Specimen in Berlin Museum......	Right hand	1.2.3.4.0;	Left	1.2.3.4.0.
British Museum I....................	" "	1.2.3.4.0;	"	1.2.3.4.0.
" " II.	" "	1.2.3.4.0;	"	1.2.3.4.0.
Rio Balsas I.	" "	1.2.3.4.0;	"	1.2.3.4.5.
" " II.........................	" "	1.2.3.4.5;	"	1.2.3.4.5.
" " III.	" "	1.2.3.4.5;	"	1.2.3.4.5.

(Fifth finger on both hands well-developed in Balsas II. and III.)

C. biporus (*Euchirotes biporus* Cope).—13 specimens in Smithsonian Institute, from La Paz in Lower California; said also to be common at Cape Lucas.

According to Cope, with tail twice as long as the head, five digits all clawed, with only one pore on either side, nasal plates nearly in contact in front.

C. tridactylus (*Hemichirotes tridactylus* Dugès). One specimen from Tecpan, near Acapulco. Tail slightly longer than the head; only three digits, all with claws; a pair of pores on either side; nasal plates widely separated.

It is remarkable that *Chirotes*, the least reduced member of the family, is the only Mexican representative of this presumably ancient group. *Rhineura* of Florida has been found in the Oligocene of South Dakota, whereby the former range is extended considerably to the north. It is very difficult to imagine how *Chirotes*, a helpless digger, without any chance of travelling, bound to sandy soil, has managed to survive, unless we assume that it is really a coast-form. Living in dunes, as it does at Cape Lucas, Lower California, it may have ascended the Basin of the Balsas, which river, from its mouth far into Guerrero, is bordered by many sand-covered ledges.

The arenicolous *Chirotes* has retained its fore-limbs, which, although short, are rather well-developed, while those genera which live in humus and rich soil have lost the limbs as usual.

The natives had no proper name for these little creatures, but described them as "culebritas con manitas."

Résumé of the Distribution of Mexican Lacertilia.

Geckonidæ.—Chiefly Antilles, North-western South America and adjoining Central America.

Eublepharidæ.—North-western Mexico and Mexican Tierra Caliente.

Iguanidæ:

1. Xerophile, humivagous; Sonoran, non-Antillean.
2. Arboreal; Central and South American and Antillean.

Tejidæ.—Neotropical, with *Ameiva* into Tierra Caliente and Antilles, *Cnemidophorus* far into United States.

Anguidæ.—Mexican, Central American and Antillean, reaching far North and South.

Xenosauridæ. } Mexican, non-Antillean.
Helodermatidæ. }

Scincidæ:

1. Northern America and plateau of Mexico, non-Antillean.
2. Central American into Mexico and Antilles.

Xantusiidæ:

1. Sonoran, non-Antillean.
2. Central American and Antillean.

Amphisbænidæ.—Mexico, Central America, and Antilles; formerly much farther north in the United States; extending far into South America.

These statements are intended, in their reduced form, to indicate the probable centres of dispersal of the various families. It is important that of these 10 families no less than 7 have representatives in the Greater Antilles, and that these Insular members belong, in not a few cases, to Insular, peculiar genera, e.g. *Cyclura* and *Metopoceros* of the Iguanidæ, *Celestus* of the Anguidæ, *Cricosaura* s. *Cricolepis* of the Xantusiidæ; and it is also worth noting that *Amphisbæna* itself occurs in Puerto Rico, on the Virginia Islands, and South and Central America, but not in Mexico. *Xenosaurus* and *Heloderma*, each the sole member of a family, are restricted to Mexico in a slightly wider sense. Most of the Anguidæ and Iguanidæ, and all the Xantusiidæ, are centred in tropical and semitropical America. We may fairly conclude that at least the Amphisbænidæ, Anguidæ, Iguanidæ, Xantusiidæ, are very old inhabitants of the ancient Sonoran-Central American and Antillean mass of land. Of these families the Amphisbænidæ may well be autochthonous. The Tejidæ alone are unmistakable Southern immigrants from an original centre, probably Brazilian, not N.W. South America; otherwise it would not be obvious why only so few Tejidæ have extended beyond the present South-American continent. They (*Anolis* and *Ameiva*) were the latest immigrants into the Central Land Complex just before the Antillean separation, after which these genera and *Cnemidophorus* could continue their continental progress northwards.

It is suggestive that so many of these families fall into a north-western, typically Sonoran and Pacific, xerophile, and a southern, more Atlantic group with predominant hygrophile characters; the Antillean forms naturally siding with the latter. The Mexican plateau, instead of connecting, rather severs these two, mainly œcological groups, the connection passing round to the south of the plateau. It must remain a moot question which of the

two groups is the older. Not unlikely both are, in America, the divergent result of more generalised features; the one with the desert, the other with the typical forest as the leading motive, or rather the ultimate theme or goal for adaptation. We do not know the physical features of ancient Sonoraland. There need have been no deserts or semiarid tracts and rather barren plateaus. The "petrified forest" of Arizona; the fact that many of the present desert-like stretches from Northern Mexico, through New Mexico to Utah and beyond, are the basins of former lakes (many of them still rapidly receding); nay, even the prehistoric towns in the now inhospitable parts of Arizona and New Mexico—all these circumstances indicate that much of Old Sonoraland is still further tending towards the formation of deserts, just as clearly as enormous parts of Central Asia.

Sonoraland had originally a much wider extent. It is obvious that the Tres Marias Islands were part of Tepic; there is also little doubt that the peninsula of Lower California was continued to the Revilla Gigedo Islands. That was at an epoch when the Gulf of California did not yet exist, the peninsula as such dating from the end of the Miocene.

OPHIDIA.

TYPHLOPIDÆ.—Only two species are known from Mexico. *Typhlops tenuis* from the State of Vera Cruz, ranging south to Guatemala; and *Anomalepis mexicana* from Nuevo Leon. The present centre of this family is South and Central America, whence they have extended into the Antilles (Puerto Rico).

GLAUCONIIDÆ.—*Glauconia*, the main genus, ranges from New Mexico, Texas, and Florida, far into South America, whence only the Lesser Antilles have been entered. Mexican localities are still very scattered. The northern species, e. g. *G. humilis*, ranges over the plateau and the Pacific slope; *G. dulcis* from New Mexico to Chilpancingo; while *G. albifrons* is a Central American, entering the Eastern and Western States of Mexico but avoiding the plateau.

BOIDÆ.—In Mexico only the Pythonine *Loxocemus bicolor*, recorded from Colima, Tehuantepec, and Guatemala; and the *Boa imperator* (incl. *mexicana*), "Masacoátl," which ranges from Ecuador through Central America into the Mexican Pacific and Atlantic Tierra Caliente, keeping strictly to the forest and bush lands. The Boinæ continue northwards as the arenicolous *Lichanura* of Lower California and of similar hot desert-like districts of Arizona; and the likewise arenicolous *Charina*, which extends from California to Washington. Another set of Boas, typical dwellers of luxurious tropical countries, occurs in the Antilles; all these, *Epicrates*, *Corallus*, and *Ungalia*, have allied species in Central and South America.

Consequently this archaic family is clearly divided into a

Pacific, terrestrial xerophile, and a more Atlantic and southern rather hygrophile stock. The former is almost typically Sonoran, except that it does not enter the plateau. Since *Charina* shows that it can endure a cold climate, the absence of similar forms on the Mexican plateau may possibly date back to the barrier of volcanic terrain.

COLUBRIDÆ.—Of the bewildering number of these snakes in Mexico only those have been selected for discussion which seem to yield some tangible results, while such as are too widely scattered or rather imperfectly known in their distribution have been mostly left out.

C. AGLYPHÆ.—*Tropidonotus*, decidedly a Nearctic genus, extending through the whole of Mexico, with greatly diminishing numbers of species into Central, but not into South America or into the Antilles. *T. ordinatus* (incl. varieties) is the commonest species in the whole of Mexico. *T. validus* is a western form, from Utah to Colima. *T. sipedon* s. *fasciatus* is eastern, from east of the Rocky Mountains to Costa Rica. Others are confined to the southern half of Mexico.

Ischnognathus is Nearctic, extending over the plateau, re-occurring in Guatemala.

Contia, clearly Nearctic, through Mexico, with preference for the plateau and its western slope, into South America.

Ficimia is Sonoran, scattered through Mexico.

Zamenis.—Sonoran. Of the 9 American species, 8 occur in Mexico, 3 of which are confined to the southern half or extend into Central America, but not into the Antilles. *Z. constrictor*, widely spread over the States, enters North Mexico. *Z. ornatus*, *semilineatus*, and *tæniatus* are typical of New Mexico, Arizona to Sinaloa, continuing as *Z. mentovarius* as a western form from Sinaloa, Colima, S. Oaxaca to Guatemala. *Z. grahami* is a central and eastern form from the Southern States right over the plateau and the East to Tehuantepec. *Z. pulcherrimus* is southern, from Salina Cruz to West Nicaragua; lastly, *Z. mexicanus* has been recorded from Colima, Central and South Guerrero, Guanajuato, and from Cape Corrientes in Jalisco *.

Coluber with *Spilotes* and *Pityophis* are clearly Nearctic, with some species in almost every State of Mexico; none is Antillean, although some extend far into South America. *C. corais*, the most powerful Colubrine Snake of Mexico, inhabits the warm and hot countries, with the wide range from the South-eastern States of North America to Brazil.

Coronella.—Nearctic. *C. regalis* from Kansas, over the plateau to Mexico City; *C. lævis* in Nuevo Leon; *C. annulata* = *micropholis* from Texas to Para, in Mexico certainly all over the

* Bocourt (Mission Scient. Mex.) states emphatically "au cap Corrientes sur le Pacifique"; it is therefore rather perplexing that Günther (Biol. Centrali-Americ.) adds "Cuba, Mus. Paris," as a locality of this species. There happens to be a Cape Corrientes at the western end of Cuba.

southern half; coloured and behaving exactly like *Elaps*, it is often mistaken for a true "Coralillo."

Urotheca, *Dromicus*, *Drymobius*, and *Leptophis* are mainly Central and South American with species in the Antilles, extending northwards into the Atlantic and Pacific Tierra Caliente, on the east side even into Texas. *Drymobius margaritiferus* is the commonest tree-snake. *D. boddaerti* ranges from South America, Trinidad and S. Vincent, and on the Pacific side it has been brought from Tres Marias Islands.

Rhadinea is South and Central American, going into Mexico east and west and onto the slopes of the Southern plateau. *Urotheca* likewise Central and South American and Cuban; *U. elapoides* from Costa Rica along the Atlantic side to Orizaba.

Streptophorus typically Central American, extending into the Atlantic Tierra Caliente. *S. diadematus* from Tabasco through Oaxaca to Jalapa and Orizaba. *S. atratus* from Ecuador and Venezuela to Jalapa. None is Antillean.

Hypsiglena torquata from Venezuela to California, in Mexico on the plateau and the Pacific side.

Atractes, *Tropidodipsas*, *Dirosema*, and *Geophis* are Southern genera, extending into the Atlantic and Pacific Tierra Caliente, the last genus with more western range. *G.* (*Geagras*) *ridimita* I have found in the sand-dunes of the lagoons near Tehuantepec.

OPISTHOGLYPHA.—*Trimorphodon*, a Mexican genus with western preference. *T. upsilon* extending northwards into Arizona, southwards to Panama; *T. biscutatus* distinctly Pacific from Mazatlan to Panama; *T. tau* on the Isthmus of Tehuantepec.

Himantodes, a typical Neotropical forest genus, of which *H. cenchoa* has spread into the Atlantic, *H. gemmistrata* and *H. tenuissima* into the Pacific Tierra Caliente. Cope's statement that *H. gemmistrata* has been found at Toluca seems to be erroneous.

These Tree-snakes are called "Súchil" in Oaxaca and on the Isthmus, are feared as poisonous, and are said to attain a very great length. Every snake, when in motion, appears to be much longer than it is, and these active creatures gliding rapidly through the dense canopy of a tropical forest seem indeed to give one the impression of prodigious length. Another name for Tree-snakes is "Bejuquillo," in allusion to lianas, which are called bejuco.

Leptodira, Neotropical, into the eastern and western Tierra Caliente, remaining outside the plateau, although *L. albofusca*, which extends to Para and Ecuador, ascends outlying mountains, like the Nevado de Colima, up to 7000 feet. *L. septentrionalis*, as the most northern offshoot, occurs in Texas and New Mexico.

Oxyrhopus, essentially South and Central American; *O. cloelia* and *O. plumbeus* stop at the Isthmus of Tehuantepec; *O. petiolarius* goes into Guerrero. This genus is of special interest since it contains the only Opisthoglyph which has reached the Antilles, but only the Lesser.

Erythrolamprus and *Oxybelis* are likewise South and Central American genera, entering the Tierra Caliente; e. g. *O. acuminatus* from South America to Motzorongo in Vera Cruz, and through Guerrero to Mazatlan; it is also on the Tres Marias Islands. *E. fissidens* extends from Costa Rica along the Atlantic side of Mexico to Tamaulipas and thence into Texas.

Conophis, South and Central American, with *C. vittatus* on the Isthmus and in Guerrero.

Scolecophis.—The few species live in rather high altitudes. *S. æmulæ* in the mountains of Chihuahua; *S. michoacensis*; *S. atrocinctus* at Toluca (*fide* Cope) and in Guatemala.

Homalocranium, with two dozen species, mostly in South and Central America, whence 8 Mexicans, chiefly on either side of the plateau, and north-eastwards, through Nuevo Leon into Texas.

These last two genera are not arboreal.

Stenorhina degenhardti from Ecuador into the Atlantic hot country.

Manolepis putnami, hitherto known only from Jalisco, *e. g.* Cumbre de los Arrastrados, 8000 feet; I have found it on the Cumbre de los Cajones, south of Chilpancingo, in pine and oak forest, altitude 3000 feet.

Petalognathus nebulatus. Of this South and Central American species I found one specimen in the forest of La Raya, south of Cordoba.

AMBLYCEPHALIDÆ.—With a few forms in South-eastern Asia, but many in South and Central America. Of the 20 species of *Leptognathus*, only *L. elegans* reaches the Isthmus of Tehuantepec.

ELAPINÆ.—Of the many species of the Neotropical genus *Elaps* only 2 or 3 occur in Mexico. The commonest, *E. fulvius*, ranges from South Brazil far into the Eastern United States. In Mexico it seems to live in the whole southern half, including the plateau, *e. g.* Mexico and Guanajuato; it is curious that it has not yet been recorded from anywhere north of a line drawn from Mazatlan to Guanajuato and Tuxpan, but Cope mentions *E. euryxanthus* of Arizona from "Chihuahua" and "Sonora." *E. elegans* seems to range from Guatemala into the Atlantic Tierra Caliente near Jalapa. No Elapine snakes occur in the Antilles. These "Coralillos," although well-known to be poisonous, are not feared because they do not bite unless handled clumsily; when they bite they do not strike, but chew deliberately like our European *Coronella*. Although occasionally found basking, they lead a very retired life, preferring vegetation, hiding under rotten stumps, with a predilection for ants' nests. They are practically nocturnal like nearly all the non-poisonous snakes which possess the same beautiful coloration; the combination of black and red rings has a most effacing effect in the dusk.

VIPERIDÆ.—CROTALINÆ, taken together, occur all over Mexico, as is to be expected of a group which ranges from Massachusetts and British Columbia to Argentina, but they fall into two lots:—

I. Northerners, with their archaic centre in Sonoraland. *Ancistrodon* is chiefly Nearctic; but of the terrestrial forms *A. bilineatus* extends along the Pacific side of Mexico, including Tres Marias Islands, to Yucatan and Guatemala. Of *Sistrurus*, east of the Rocky Mountains, *S. ravus* has been described by Cope from Vera Cruz. *Crotalus*, the main genus, radiates out from the tablelands of Arizona; *C. terrificus* (*horridus* of some authors) is the only species which extends right through Mexico to the Isthmus, and thence right into Argentina, avoiding, however, the moist and wooded Tierra Caliente. It is the only Rattlesnake in South America. *C. triseriatus* is confined to Mexico's mountains, ranging from the Nevado de Colima right across to Citlaltepetl, where I have found it at an altitude of 12,500 feet.

II. Southerners.—*Lachesis*, an essentially Neotropical genus, a few species of which extend into the Eastern and Western States below the plateau. *L. lansbergi* has the widest distribution, and it is the only Pit-viper which has entered the Lesser Antilles, the larger and older islands being free from poisonous snakes.

The Rattlers, or "Viboras de cascabél," are not much feared, being "manzitos" (rather tame), meaning sluggish and not inclined to strike unless provoked; moreover, they always try to give fair warning with the rattle, which they sound only when coiled up and prepared to strike, but not when crawling away as they generally attempt doing. The *Lachesis lanceolatus*, the "Fer de lance" of Martinique, &c., "Rabo de hueso" or Bone-tail of the Mexicans, on account of the curiously coloured and spike-like tip of the tail, behaves quite differently. It is very quick, highly irascible, and even known to make for its pursuer, therefore much dreaded. In fact the few cases of snake-bite which I could ascertain, mostly fatal, were due to this species.

Résumé of the Distribution of Ophidia.

Typhlopidæ.—Central and South American, Atlantic Mexican and Antillean *.

Glauconiidæ.—Remnants of Sonoran to Neotropical distribution; they may reasonably be expected to be found in the Antilles.

Boidæ.

1. Xerophile Sonoran, not Antillean.
2. Hygrophile Central South American, Mexican Tierra Caliente, and Antillean.

* For the present purpose only those Snakes are considered Antillean which occur in the Greater Antilles. The Lesser Antilles, entirely volcanic and of much younger date, have received the *Lachesis*, *Oxyrhopus*, and *Glauconia* directly from the opposite part of Venezuela.

Aglyphous Colubrinæ.—Obviously with an archaic Nearctic centre. There is a gradual change from North to South.

1. Northerners which send a few species only into Central and still fewer into South America *, while none reaches the Antilles: *Tropidonotus, Ischnognathus, Contia* *, *Ficimia, Coluber, Spilotes, Pituophis, Coronella* *. Here also *Zamenis.*
2. Central Americans, from the Mexican Tierra Caliente into South America and into the Antilles ** : *Urotheca* **, *Dromicus* **, *Drymobius* **, *Leptophis* **, *Rhadinea, Streptophorus.*
3. Essentially Southerners with their present centre in South America, extending northwards into Mexico, but not into the Antilles: e. g. *Atractes, Tropidodipsas, Dirosema, Geophis, Xenodon.*

Opisthoglyphous Colubrinæ.—Essentially South and Central American, with many mostly arboreal forms in the hot countries of Mexico, whilst a few terrestrials extend also over the plateau and into the neighbouring United States. None Antillean.

Elapinæ.—Neotropical, non-Antillean; but a few species of *Elaps* range through Mexico, and one far into the United States.

Crotalinæ.

1. Nearctic, especially Sonoran, xerophile, non-Antillean. Only one of them extending far into South America.
2. Neotropical, northwards into the Mexican Tierra Caliente, and into the Lesser Antilles.

All this means that the Greater Antilles possess only the ancient *Typhlopidæ* and perhaps *Glauconiidæ* and have received those Boas and Aglyphous Colubrines which have near relations in Central and North-western South America, whilst *Crotalinæ, Elapinæ*, and *Opisthoglyphæ* are excluded. Further, this indicates that all these latter groups are post-Antillean, that they have extended southwards after the Antillean separation, have developed into the present tropical genera and species in Central and South America, and have then, eventually, most recently extended northwards into or even beyond Mexico, just as some obviously Nearctic species are still extending southwards.

Distribution of Mexican Species according to Altitude.

Our knowledge of the fauna of North-western, Northern, and North-eastern Mexico is too imperfect. The calculations are therefore restricted to those parts of Mexico which lie within the following lines: Mazatlan—Guanajuato—Mizantla, north of Jalapa in the State of Vera Cruz; and Coatzacoalcos, across the

Isthmus to San Mateo del Mar near Tehuantepec. These lines enclose all the most varied and characteristic physical features: the highest mountains, part of the Central high plateau with gradual slopes into the lowlands, abrupt boundaries, the hot lowlands, the principal rivers, lakes, swamps, forests, and savannahs; Central or inland, Atlantic and Pacific climate.

All the species, with available records, were sorted into six groups:—Those which occur only in the cold and cool regions; those which are found in these and in the temperate zones; in the cool, temperate, and hot zones; temperate zone only; temperate and hot; and, lastly, hot or tropical only.

Of course the lines of demarcation are quite arbitrary, but the 132 species collected by myself, represented by about 1000 specimens, with my knowledge of the country, gave me a lead. Hot-lands extend from the sea-level to about 3000 feet, the temperate zone to 5000 or 6000 according to the district. Everything beyond 7000 feet can safely be considered within the cool zone, and all stations above 9000 feet are decidedly cold. Lastly, there is some safety in numbers.

I. My own Collections: 131 species employed.

Climate.	No. of species.	Per cent	
1. Cold or cool only......	22	17	
2. Cold and temperate...	6	5	within cool zone 38 sp.= 30 per cent.
3. Cold to hot	18	10	
4. Temperate only	12	9	within temperate zone 42 = 32 per cent.
5. Temperate and hot ...	11	9	within hot zone 91 = 70 per cent.
6. Hot only	67	51	(groups 6+5+3).
	131	101	

II. My own and previous Collections and records: 247 species, then rounded up to 250.

Climate.	No. of species.	Per cent.	
1. Cold or cool only......	42	17	
2. Cold and temperate..	20	8	within cool zone 86 sp.= 34 per cent.
3. Cold to hot	24	9·6	
4. Temperate only	15	6	within temperate zone 99 = 40 per cent.
5. Temperate and hot...	40	16	within hot zone 173 = 69 per cent.
6. Hot only	109	43·6	(groups 6+5+3).
	250	100·2	

These two calculations agree remarkably well: species restricted to cool regions 17 per cent. in both cases; species occurring within the cool regions 30 or 34 per cent. respectively; and species

recorded from the hot-lands 70 or 69 per cent.! I have left the two lists as they are, for fear that a revision would not be free from bias and might thus prove too much *.

Fairly established is the fact that the Tierra Fria is inhabited by about 34 per cent., one third of the total number of species, of which one half, *i. e.* 17 per cent., are restricted to the cool and cold zone.

Equally safe is the conclusion that in the Tierra Caliente occur 69 or 70 per cent., about 50 of which (51 or 43) are restricted to it. This shows the richness of tropical life, especially if we consider the small extent of the hot-lands in Mexico in comparison with the rest of the country.

Text-fig. 30.

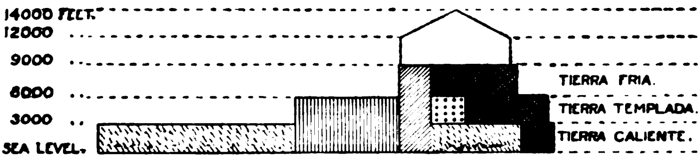


Diagram of the distribution of 250 Mexican species according to *Altitude*.

		Per cent.
Southern or hot-country species.	Restricted to the Tierra Caliente	44
	Ascending into temperate zone	16
	Ascending into cool zone	5
	Species restricted to the temperate zone	6
Northern or cool-country species.	Restricted to cool and cold zone	17
	Descending into temperate zone	8
	Descending into hot zone	4
		100

Further, the whole fauna is practically composed of these two groups, whilst the species restricted to the temperate zone form a very small minority, 6 per cent., at the utmost 10 per cent. if we allow for the difficulty of classifying.

This shows that the original stocks were either cool or tropical,

* Probably all the numbers of species, as put down for the six groups, have been understated, but this would not much alter the proportions. For instance, on p. 228, the species given as occurring in cool to hot zones amount to about 24, but even half a dozen more might be added according to the interpretation of such records as "Amula" and "Omilteme," which may mean anything from 5000 to 8000 feet.

in other words either Northerners, as natives of Old Sonoraland, dwellers of mountains and high plateaus, or Southerners, which were and are mostly tropical species. The temperate zone is in the present case rather no-man's-land than the happy medium favourable to the majority.

The configuration of the whole country lends every support to this result; broadly speaking, a high, mountainous plateau, abruptly falling off into tropical lowlands.

The species which have such a considerable range of altitude that they occur in the cool, temperate and hot zones, are of further interest. The same kind which is bound to hibernate on the high mountains is active throughout the year in the moist and hot lands, and possibly there are some which also æstivate during prolonged drought. The species can be grouped as follows:—

I. Undoubted Northerners, or originally at home in a cool climate, as indicated by their main distribution, or by that of allied species of the same genus. These have *descended* into the hot lands.

Scaphiopus dugesi.	*Tropidonotus melanogaster.*
Rana halecina.	,, *ordinatus.*
,, *montezumæ.*	,, *validus.*
Sceloporus scalaris.	*Coluber triaspis.*
,, *microlepidotus.*	*Crotalus horridus.*
Uta bicarinata.	*Cinosternum pennsylvanicum.*
Gerrhonotus cæruleus.	

II. Essentially hot-country species which have *ascended*; and it is remarkable that most of these are not found on the plateau proper, although they ascend the surrounding mountains, up to an altitude equal to or surpassing that of the plateau. This fact seems to indicate that the respective species are still continuing their upward spreading, or that they have conquered these mountains comparatively recently. This fits well with the suggestion expressed on p. 244 that the Southern or tropical fauna of Mexico represents for the greater part the most recent immigrants. The Sierra Madre del Sur affords a good illustration. It is separated from the plateau by the depression of the basin of the Rio Balsas. Tropical species coming from the south can surge up to the Sierra, and they have ascended its higher mountains (*e. g.* those of Omilteme, Amula, Cerro de S. Felipe near Oaxaca), and the backbone itself is of no mean height; but then comes the descent into the hot basin, then again the ascent of the plateau. A tropical species, which has succeeded in acclimatising itself to life on the Sierra, will have to "undo" this hardening, become tropical again, and lastly once more ascend and accommodate itself to a cool climate. Of course all this can be done, but it takes time. The same applies to the fauna of the rather isolated Volcan and Nevado de Colima. The ranges of mountains which border

the great plateau are rather abrupt and in many parts are even higher than the plateau itself, so that to gain the latter would imply a descent. There are, as mentioned elsewhere, p. 240, regions which offer a gradual, easy entry, and they have facilitated the exchange of many species, but not of all, and of course not in other districts.

Species found in the hot country and on high mountains; those excluded from the plateau are marked *:—

* *Hylodes rhodopis.*	* *Leptodira albofusca.*
* *Anolis nebulosus.*	* *Xenodon rhabdocephalus* (?).
* *Zamenis mentovarius.*	*Geophis chalybea.*
* *Rhadinea vittata.*	*Trimorphodon upsilon.*
* *Leptophis mexicana.*	*Elaps fulvius.*
* „ *diplotropis.*	

III. Lastly there are some species which are difficult to group, whether they have descended or ascended. For instance, most kinds of *Hylodes* live rather high up; they want permanent moisture, and this *H. rhodopis* gets on the high mountains and in the hot forests of the Atlantic side; only a very few returns have been made from the truly temperate zone, and it is not known from the plateau.

Hyla eximia.	* *Sceloporus formosus.*
* *Bufo intermedius.*	* „ *acanthinus.*
* *Hylodes palmatus.*	„ *spinosus* (?).
Sceloporus variabilis.	*Coronella micropholis.*

The list (*infrà*, pp. 232–233) contains 70 species, of which 8 (*Diploglossus*, *Xenosaurus*, 1 *Zamenis*, 3 *Leptophis*, 1 *Drymobius*, and 1 *Sceloporus*) may be deducted as probably not ascending beyond 6000 feet. The remaining 62 species, out of a probable total of 250 for Mexico from between the Isthmus of Tehuantepec and the line Mizantla to Mazatlan, represent about 25 per cent. Of these, again, 30–32 (13 per cent.) seem to be restricted to levels above 7000 feet. These have been marked with an asterisk (*). If we add to them the following 10 species, which seem to be restricted to the high plateau, 6000–8000 feet:—

Spelerpes morio (also from "Jalapa"),	*Tropidonotus variabilis,*
Scaphiopus multiplicatus,	„ *scaliger,*
Bufo compactus,	*Homalocranium bocourti,*
Hyla miotympanum (?),	*Crotalus miliarius,*
Phrynosoma orbiculare,	„ *salvini,*

we get a total of about 42 species, equalling 17 per cent., as restricted to the cold and cool zones (*cf.* p. 228).

List of Species recorded from Mexican Mountains within the Cool Zone.

[The Plateau, *e. g.* Valley of Mexico, Puebla and Zacatecas, is not included.]

	Citlaltepetl.	Cerro de S. Felipe, near Oaxaca.	Amula, Sierra Madre del Sur, between Oaxaca and Chilpancingo.	Omilteme, Sierra Madre, West of Chilpancingo.	Nevado de Colima.	Cumbre de los Arrastrados.	Sierra de Ajusco, near Mexico.
Thorius pennatulus	9000	8000					
Spelerpes orizabensis	8000–12,500						
— *leprosus*	8000–12,500						
— *chiropterus*	9000–10,000						
— *belli*	......	......	......	*			
Batrachoseps attenuatus	......	......	......	......	7200		
Amblystoma tigrinum	......	......	......	......	......	8500	
— *altamirani*	......	......	......	......	......	7900–8800	
Bufo intermedius	......	......	......	7100			
— *simus*	......	......	*	7100			
Hylodes rhodopis	8000–12,000	8000	......	......	6600–8900		
— *palmatus*	......	......	......	*			
Syrrhopus omiltemanus	......	......	......	*			
Borborocœtes mexicanus	......	......	......	7100	6270–8250		
Tomodactylus amulæ	......	......	*				
Hyla eximia	......	......	......	......	......	Sierra de Cayatlan, 8000	
Rana halecina	......	......	......	7100	......	*	8000
— *omiltemana*	......	......	......	*			
Sceloporus torquatus	......	7000	......	*	5000–7200		
— *bulleri*	......	......	......	......	......	4400–8500	
— *yarrowi*	......	......	......	......	......	3480–8500	
— *acanthinus*	8000	7000	*	7300			
— *asper*	......	......	......	......	......	8500	
— *formosus*	8000	......	......	......	7200		
— *microlepidotus*	13,000	8000	......	8000 *	7200–11,000 *	......	8000 *
— *heterolepis*	......	......	......	......	......	7800–8500	
— *æneus*	8500–13,500	......	......	......	8900	*	8500 *
— *scalaris*	10,000–14,000	7000	*	......	......	......	8500 *
— *variabilis*	......	......	*	......	8900		
— *spiniferus*	......	......	......	?			

Phrynosoma taurus	......	......	8000				
Gerrhonotus antauges	8500						
—— *deppei*	8500						
—— *gramineus*	8500–9000						
—— *imbricatus*	6000–7800	......	......	......	11000		
—— *liocephalus*	......	......	......	8000			
Eumeces lynce	......	......	......	8000	6800–7000		
—— *brevirostris*	......	......	......	......	7000		
Anolis gadovii	......	......	......	7600			
—— *nebulosus*	......	......	......	......	6600–7000		
Diploglossus steindachneri							
Xenosaurus grandis							
Tropidonotus scalaris	8000–12,500	......	......	......	......	*	
—— *chrysocephalus*	......	......	6000–8000	7100			
—— *melanogaster*	......	......	......	......	8200		
—— *ordinatus*	8500–12,000	......	*	......	......	*	
—— *godmani*	......	......	*	*			
Zamenis grahami	......	......	6000				
—— *mentocarius*	......	......	? *				
Xenodon rhabdocephalus	......	......	*				
Contia nasus	......	......	......	*	......	......	8800
Toluca lineata	......	......	......	......	......	......	Toluca, 8600
Dromicus laureatus	......	......	......	......	......	......	*
Geophis mæsta	......	......	......	*			
—— *omiltemana*	......	......	......	*			
Coluber chlorosoma	......	......	*				
Manolepis putnami	......	......	......	......	......	8500	
Ischnognathus copei	......	......	......	......	......	8500	
Leptophis diplotropis	......	......	? 6000				
—— *præstans*	......	......	? 6000				
—— *bilineatus*	......	......	? 6000				
—— *mexicana*	......	......	? 6000				
Drymobius margaritiferus	......	......	? 6000				
Leptodira albofusca	......	......	......	......	7000		
Trimorphodon upsilon	......	......	......	......	......	*	
Rhadinea vittata	......	......	......	7100	......	*	
Homalocranium atrocinctum	......	......	......	......	......	......	Toluca.
Crotalus triseriatus	9000–12,500	......	......	*	8250	......	Toluca.
—— *terrificus*	......	......	......	*			
Lachesis undulatus	......	......	......	*			

General Conclusions.

1. *Evolution of Middle America.*

We have seen in the review of the Amphibian and Reptilian fauna of Mexico that it is composed of Northern and Southern immigrants; that a considerable number of the northern group can claim to be old, autochthonous Nearctics; that some families, genera, or species have also representatives in the Antilles, and that most of these forms point unmistakably to Central America, or even further south, as their original home; lastly, that but few Antilleans belong to a northern stock.

The explanation lies in the geological history of this part of the world. I restrict myself on purpose to this part, lest such an inquiry should lead to a discussion of the whole globe since the first dawn of Amphibian life in some Palæozoic country.

Our present task limits itself to the Tertiary period. It is doubtful whether any of the genera in question are older than the Eocene, but not a few can be proved to have existed in our region in the mid-Miocene epoch; and it is surprising that they should date so far back. Lastly, there was no Central America in the Cretaceous period.

The building up of Mexico and neighbouring countries seems to have taken place as follows, so far as I can gather from the writings of A. Agassiz, Suess, Lapparent, R. T. Hill, J. W. Spencer, J. W. Gregory, C. Sapper, and José G. Aguilera *.

The accompanying consecutive series of maps illustrate my abstract conclusions, and only in this abstracted sense can claim originality.

Mexico came into existence during the Lower Cretaceous epoch. To a nucleus of land, Sierra Nevada and California, were added the Rocky Mountains and the bulk of the Mexican Plateau. This large complex I call the *Old Sonoraland*. It is important to remember that it was separated, during the Upper Cretaceous epoch, by a broad belt of sea from the eastern and northern parts of North America. A third mass of land existed as Brazilialand. In the meantime appeared Antillean lands, and, possibly in sympathy with the east to west trending mountains of Honduras

* Suess.—Das Antlitz der Erde. De Lapparent.—Traité de Géologie.

R. T. Hill.—"The Geology and Physical Geography of Jamaica: Study of a type of Antillean development." Bull. Mus. Comp. Zool. Harvard, xxiv. (1899) pp. 1-226. See also other papers in same Bulletin, xvi. (1895), and in Amer. Journ. Sci. vol. xlviii. (1894).

J. W. Spencer.—"Reconstruction of the Antillean Continent." Bull. Geol. Soc. America, vol. vi. 1895; and Geolog. Mag. 1894, pp. 448–451.

A. Agassiz.—Reports of the Results of Dredging ...... by the 'Blake.' Mem. Mus. Comp. Zool. x. (1883) no. 1, p. 79.

J. W. Gregory.—"Contributions to the Palæontology and Physical Geography of the West Indies." Quart. Journ. Geol. Soc. vol. li. (1895) pp. 255–312.

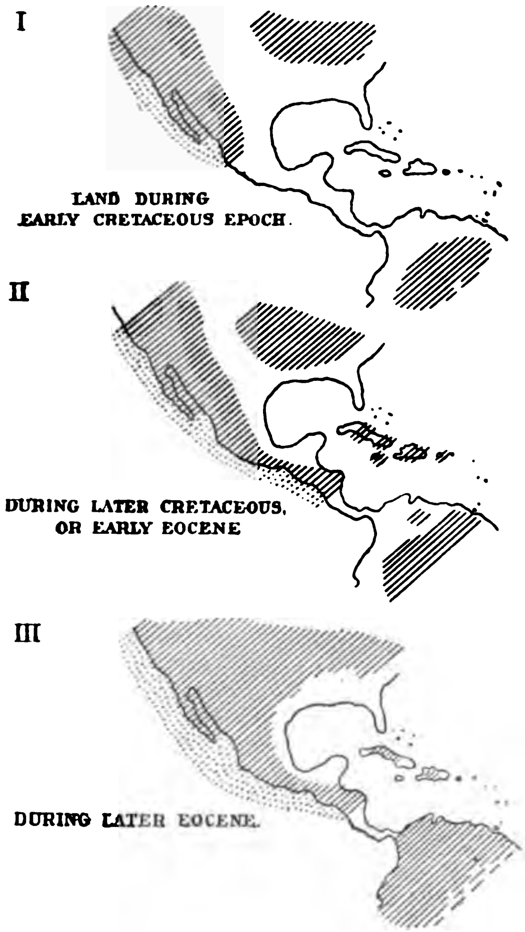
J. G. Aguilera.—"Bosquejo Geológico de Mexico." Instituto Geológ. de Mexico, pt. 4 (1895) pp. 1-270, with maps.

C. Sapper.—"Sobre la Geografía física y la geología de la peninsula de Yucatan." Inst. Geol. Mexico, pt. 3 (1896).

and Guatemala, also the Mexican Sierra Madre del Sur. These parts were in time annexed by Sonoraland.

By the late Eocene, conditions were so far consolidated that there existed the present North American Continent, eastern and

Text-fig. 31.

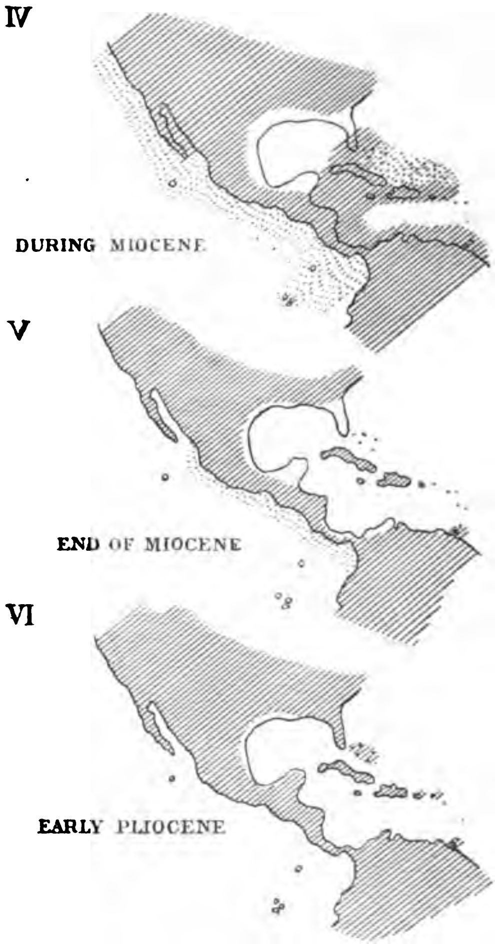


Diagrams to illustrate the contours of Mexico at different geological ages.

western halves joined, and the latter extending southwards as the present Mexico and part of Central America. Brazilia had grown into South America, but the two continents were still separated, the Atlantic and Pacific communicating across the present Isthmus of Panama and probably further north.

Late Eocene, or early Oligocene, times mark a period of considerable local subsidence which drowned the Antillean land, or islands, except their summits. Late Oligocene, or early Miocene, mark a period of considerable elevation with most important

Text-fig. 32.



Diagrams to illustrate the contours of Mexico at different geological ages.

results:—Establishment of the continuity of North and Central with South America, and a continuous mass of land from Central America, north and eastwards, comprising the Greater Antilles and the southern end of Florida. For this Central Land (Antilles + Central America proper, and adjoining parts of South

America, viz. Colombia and Venezuela) I use the name of *Great Antillia*, the term Antillia having already been used by others. The present Gulf of Mexico remained below the sea, and was larger than it is now, covering the Atlantic Tierra Caliente of Mexico, Yucatan, and, according to Hill, the main part of Florida. If correct, the latter point is important.

It seems also probable that the Mexican-Central American land, during the Miocene epoch, extended considerably further westwards than the present Pacific coast, taking in with almost certainty the Revilla Gigedo Islands.

Late Miocene, or early Pliocene, comprise a time of subsidence, resulting in the present features. Severance of the Antilles into the present islands, which since have undergone comparatively unimportant changes of shape and extent; separation of Florida. Lower California became a peninsula, owing to the formation of the Gulf of California. The Revilla Gigedo Islands, still later the Tres Marias, are remnants of the subsiding land. Yucatan appears at the beginning of the Pliocene epoch*. The Isthmus of Panama is limited to its present narrow dimensions.

A few words remain to be said about the volcanic activity and other changes affecting the configuration of the Mexican Plateau. A tremendous dislocation, at the latest in Eocene times, produced the Eastern Sierra Madre, composed entirely of Cretaceous limestones, raised up high, forming the elevated eastern rim of the plateau, and falling off abruptly towards the Atlantic lowlands.

In the Eocene epoch began also the enormous outburst of volcanism, raising the Western Sierra Madre, piling up gigantic masses of igneous rocks, mostly andesite, and lavas, which continued to spread over a vast part of the country during most of the Miocene epoch, and, more locally, even in historic times. Most of the plateau is now covered with the Quaternary debris, sand, &c., which overlie the eruptive masses and the older calcareous or limestone formations. These accumulations of more or less sandy soil form plains, mostly treeless. They are of great extent, in the northern half, from Texas to Zacatecas. In the middle, say from Guadalajara to Puebla, exist a great number of smaller plains or "valles," that is to say fertile plains, interrupted or partly surrounded by the outcropping hills of volcanic formation, and they contain a fair number of lakes. In the south of Mexico, in the States of Oaxaca and Guerrero, such plains are rare or absent. Trees are scarce or absent on the plateau; it is an idle fable that it was well-wooded in historic times. The bordering high Sierras and their slopes are well-wooded, densest on the moist, Atlantic side. The eastern, southern, and western Tierra Caliente is covered with luxurious growth, either forming continuous forests or showing the features of savannahs.

The plateau is dry, verging towards prolonged droughts, interrupted by few, occasionally torrential, rains. The Atlantic

* See footnote to p. 242.

hot-lands and the eastern slopes of the States of Vera Cruz and Chiapas are very wet, with a very long and abundant rainy season, interrupted by a short dry time in the winter. The Pacific side is much drier; the actual amount of annual rainfall is considerably less and the dry winter period is much longer.

The plateau rises from less than 1000 feet near Laredo, and 3800 at El Paso, gradually to about 6000 at Aguas Calientes and Querétaro, and above 7000 at Mexico City and Puebla. The highest masses of mountains, bordering the plateau, lie in the south-east, south and west, culminating in the snow-capped peaks of Citlaltepetl or Volcan de Orizaba, Popocatepetl, Nevado de Toluca, and Nevado de Colima.

2. *Immigration and Spreading.*

Obviously these physical conditions influence the fauna now; what they were like in bygone ages we can only surmise. Ranges of mountains are by no means always barriers; on the contrary, they help the dispersal along the lines of their long axes. Regions covered by the sea are of course not available. The same applies to districts which are subject to volcanic eruptions. This is very important for Mexico. Not only the Western Sierra Madre with its continuations to Colima and thence towards Puebla, but also almost the whole of the plateau became covered with eruptive masses, and, considering the immense extent of this terrain, a long time must have elapsed before it became available for plants and animals. We may well ask, what remained of the country as suitable for life. Of course, probably, there were archaic tracts standing out, not affected by these revolutions, but these gneisses, schists, and granites form scattered enclaves. I think it was the Pacific strip—Sonora, Sinaloa, Tepic, and part of Jalisco—which was not affected; in fact, the Pacific slopes, together with the land which has since sunk below the Gulf of California. On the eastern side, part of the plateau did not suffer from eruptions, but the land was still narrowed; there was no Atlantic lowland, this being during the whole Miocene epoch, and even later, still below the sea. Consequently we have as available land the western strip as the least altered remnant of Old Sonoraland, and the present eastern limestone belt, beginning with a broad basis in Texas, and extending through Coahuila and Nuevo Leon southwards, narrowing down towards Oaxaca. These were the two belts of land available for spreading southwards. Obviously the Pacific belt is the older of the two, the north-east of Mexico, with Texas, being late Cretaceous terrain. Once arrived in the south of the plateau, there was the essentially granitic, gneissic, and older Cretaceous terrain of Guerrero and Oaxaca, not so much overlaid by volcanic masses. Thence the Great Antillia afforded easy access into the present Antilles. But it was a long way round from the North. The spreading from South America into this same Antillia was easier in this respect.

Later immigrants from the North into Mexico are those of the

plateau, which by climate and every other physical feature is a direct continuation of the more northern countries. Hence the imperceptible change from Arizona, New Mexico, and Texas southwards. The political frontier between Mexico and the United States is no boundary whatever for our purposes.

For northern animals and plants the drier climate, not so much the annual mean temperature, of the plateau suggests this as a natural limit, but not a few northern forms, even the same species, have adapted themselves to life in the hot lowlands and have extended their range far south, even into South America. With the original natives of the latter continent, conditions are different. They could spread easily through Central America, but arrived in South Mexico the wedge of the plateau divides them into an Atlantic and a Pacific mass. They can go a long way north, and are still in Tierra Caliente, like the countries whence they came. But a sifting takes place. The Atlantic lowlands are hot and moist, whilst the Pacific slopes and much narrower lowlands are hot and rather dry, the dryness increasing rapidly towards the north. To people such divergent countries implies a severe sifting of the immigrants, or the necessity of changing, by adaptation to, or by, the new surroundings.

This is well illustrated by the gradual change, from species to species, of essentially northern into slightly less northern, into almost tropical forms of the same genus; or, since a genus is in most cases an imaginary abstract, of the same group of closely allied creatures. Still further south that particular genus comes in most cases to an end. There may be a species or two which form outposts, straggling on, perhaps in actual process of successful adaptation; however, after all the genus has found its limit. But it is there not met by the outposts of the southerners; they in their turn stand much further north. If it were otherwise, there would be a real boundary line, with a kind of neutral zone between North and South, and this neutral zone should contain comparatively few species and genera. Emphatically this is not the case. The two faunas overlap broadly; they commingle, except on the plateau, which seems to be a much more effective barrier to the southerners than is the descent from the plateau into the hot lowlands to the northern creatures. It seems to be easier for xerophile northern genera, and even species, to go south and to adapt themselves to life in a more equably hot and decidedly moister country with luxurious vegetation, than for hygrophile southerners to do the reverse.

Be it noted, however, that this applies only to those terrestrial northerners which can adapt themselves to arboreal life; rattlesnakes cannot do it. Speaking broadly, xerophiles are essentially humivagous; hygrophiles either live on the ground which is rich in humus, grass, or herbaceous tangle and underwood, or they are arboreal.

A favourite way of adaptation is arboreal life, whereby the xerophiles escape inundations, accumulation of humus, debris,

and the gloom of the underwood. In a desert or semidesert the amount and character of the scarce and precarious vegetation remain practically stabile; not so in the Pacific lowlands. During the rainy season grows up a dense mass of herbaceous plants covering the ground with a tangle of weeds, tall Salvias and Composites, stinging herbs and spiny creepers; all this disappears, is burnt up, scattered during the dry season, and for months the ground may be bare, whilst many of the trees are leafless. In this Pacific type of Tierra Caliente we have periodical extremes. Different again is the moist Atlantic Tierra Caliente, and also the ranges of mountain forests of the Southern and South-eastern Tierra Templada. There are no extremes; the very opposite to arid tracts; there is plenty of high and low vegetation all the year round.

The important factor is not the temperature, nor the altitude as such, but the amount, or rather the distribution, of annual moisture. Temperature: more than the northern half of the Mexican plateau belongs to one of the hottest regions of the world, the centre of heat being the State of Sonora. From May to July the mean temperature for Sonora is 36° C. = 96·8° F.; for the rest of the northern plateau 30° C. = 86° F., which is *more* than the summer average of South Mexico and Central America. But in the winter the North averages 16° C. = 60·8° F., while the Tierra Caliente enjoys 25° C. In short, the Hot-land temperature averages from 25° to 28° C. = 75° to 82° E.; the Northern plateau from 60° to 96° F., with additional extremes from frost and snow to unbearable broiling heat and drought.

The overlapping, mentioned above, is much more generic than specific. There are, indeed, very few species which, although having a wide geographical range, are well established in stations of decidedly very different physical aspect. For instance, species on the higher mountains, or plateaux, and also in the Tierra Caliente: see p. 231. But of all these only very few, e. g. *Hylodes rhodopis*, *Sceloporus scalaris*, a Rattlesnake, and *Tropidonotus ordinatus*, can, in their indifference to physical conditions, be compared with the Puma, the Armadillo, Opossum, the Raven, and Turkey-Buzzard.

Some species, natives of the plateau, descend from it down to the neighbouring coast (*Bufo simus*, *Hypsiglena torquata*, *Zamenis grahami*); others ascend from the hot countries on to the plateau, especially from the west by way of Guadalajara, and thence to Guanajuato and further east, the means being the alluvial plains spoken of before; or the ascent can be traced through the Balsas depression towards Iguala and Cuernavaca; another opportunity seems to lead from the east side to Zacualtipan in the State of Hidalgo. Such ascending species are *Bufo marinus*, *B. valliceps*, *Hyla miotympanum*, *Engystoma ustum*, *Phyllodactylus tuberculosus*, *Uta bicarinata*, *Zamenis mexicana*.

To another category belong those species which have a wide, but very scattered, discontinuous distribution, especially those

which, like most *Gerrhonotus*, are now restricted to the higher mountains.

Lastly, a considerable number of Southern species ascend from the hot lowlands high up onto mountains which rise isolated, or which fringe the plateau.

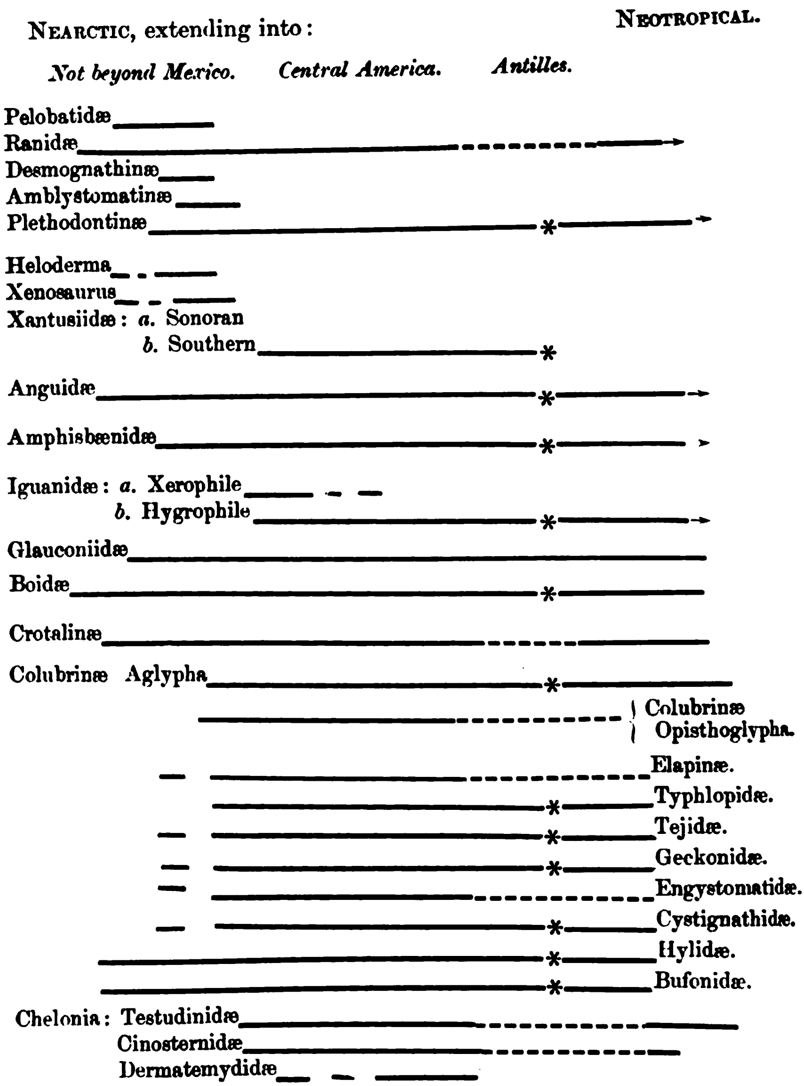
Of course it is difficult, perhaps premature, to generalise in this respect, and sharp lines cannot be drawn between these categories. Not the least cause is the vagueness or doubtful nature of many of the reported localities. For instance, Cope had various correspondents in Mexico, and some of the alleged localities are quite impossible. Peters had a good correspondent resident in Puebla City, but the specimens which now figure as "Puebla" came from anywhere in that State, which has the most perplexing, intricate boundaries, and contains altitudes from 3500 to less than 100 metres! "Vera Cruz" is another snare to the unwary. Others have bought specimens, even collections, in Mexico City. I myself found in a shop at Orizaba several large glass vessels full of well-preserved snakes for sale, but I left them alone since nobody knew where they came from. Sumichrast lived for many years in Tehuantepec and he travelled widely, all over the Isthmus and beyond. The town is situated on a plain, about 100 feet above the not distant sea; within a few hours' ride are mountains, covered with pines, well above the Tierra Caliente, as typical of which every specimen labelled "Tehuantepec" is put down.

I shall not, at least in this paper, go into the detail of the generic overlapping, a very important question. Suffice it to say, that in many cases the species of a genus are so distributed that some are decidedly northern, living on the plateau, typical inhabitants of the Tierra Fria; another species lives in the adjoining Tierra Templada, more often on the western than on the eastern slopes and descending more or less far into the lowlands; while a third kind is confined to the typical tropical Tierra Caliente. Such cases are clearly illustrative of the evolution of species due to the prevailing physical conditions, especially when none of these species has a wide geographical range.

Are we justified in calling a certain species ancient because it has a wide continuous range? For instance, *Tropidonotus ordinatus*, *Crotalus terrificus*. It is rather doubtful, because these creatures are so indifferent to climatic conditions. With more right we consider those as ancient which have to be very particular about their terrain, and which are now scattered, without the least chance of communication—as, for instance, *Thorius*, *Chirotes*, *Heloderma*, and other slow, or digging, creatures.

3. *Northern and Southern Immigration.*

In the following table the Mexican Amphibia and Reptiles are divided into a Northern or Nearctic and a Southern or Neotropical mass, according to their presumable ancestral home or centre of



dispersal so far as America is concerned. Those which have sent forms into the Greater Antilles are also indicated.

The Greater Antilles have received their fauna* from Nearctic

* Gregory thinks it is "almost certain" that Yucatan was connected with Cuba. Other zoogeographers have likewise assumed this connection, and it looks very plausible on the map. If it ever existed, it must have been very transitory. Amphibia

and from Neotropical groups, of both Amphibia and Reptilia, but no northern group has contributed, unless it had spread well into Central or even into South America (witness the Plethodonta, Anguidæ, Amphisbænidæ, Scincidæ, Xantusiidæ, Aglyphous Colubrinæ, Iguanidæ).

All these Nearctic, or Old-Sonoran, groups must have been there in Miocene times. The same age must be assigned to the outhern immigrants—the Cystignathidæ, Hylidæ, Bufonidæ, Tejidæ, Typhlopidæ.

On the other hand, the following must be considered as decidedly post-Miocene so far as their existence in the present Central America is concerned: from the North the Pelobatidæ, Desmognathinæ, and Amblystomatinæ, none of which extend, southwards, beyond Mexico proper; from the South the Engystomatinæ, Opisthoglypha, Elapinæ, none or few of which go beyond Mexico into the United States. Lastly, the latest arrivals in South America are the Crotalinæ, of which only *Lachesis lanceolatus* has entered the Lesser Antilles.

Ancient Sonorans are *Heloderma* and *Chirotes*.

The Testudinidæ are also Old Sonorans. Still with fair numbers in Mexico, but ever decreasing southwards through Central into South America. *Testudo* has arrived in Central and South America too late for the Antilles, but in time for the Galapagos. This indicates that the Caribbean Sea and Gulf of Mexico connection was established before the disappearance of the western extent of Central American land. It is another hint that the Isthmus of Panama is but the last vestige of a former much broader land-connection between the two Continents.

Concerning the Colubrine Snakes, they remind us in their dispersal southwards of the Iguanidæ, Anguidæ, and Boidæ. They have gone in detachments. The earliest migrants, when arrived in South America, have developed there, and since, into Opisthoglypha and the Aglypha part 3; and these are now surging back, northwards, post-Antillean. A second lot are the Aglypha part 2, many of which have entered the Antilles. Lastly, the last detachment of northerners passing through Mexico and Central America, too late for the Antilles, but still continuing their southward migration.

If I am right in the conclusion that American Colubrinæ gave rise to Opisthoglypha in South America, it follows that Opisthoglypha are not a natural group, those of the Old World, chiefly palæotropical, being an instance of collateral development, convergent, homoplastic, or whatever term may be preferred.

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and Reptiles do not support it; on the contrary, their present distribution is opposed to it.

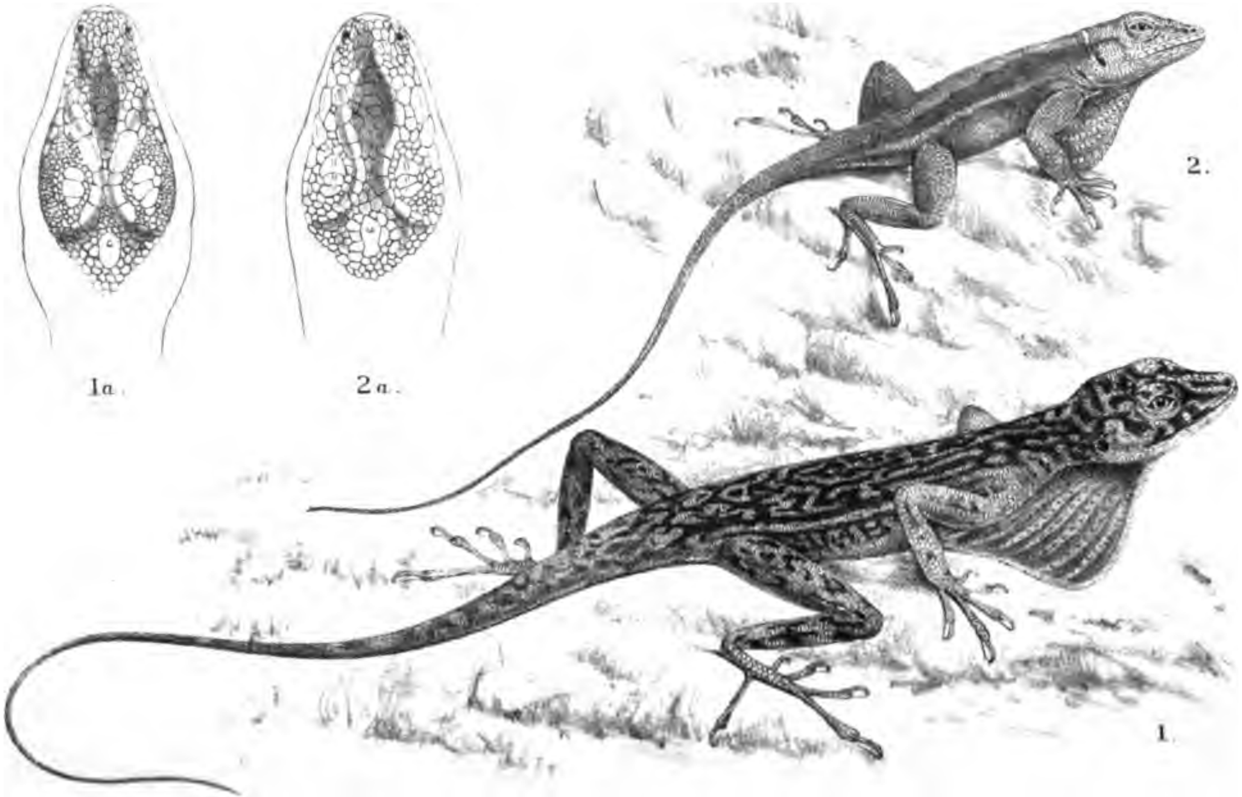
About 70 species are known from Yucatan. Its fauna is essentially that of the Atlantic Tierra Caliente: it differs from that of the Antilles apparently by the absence of Xantusiidæ, Glauconiidæ, and Anguidæ. On the other hand, it is inconceivable why Tortoises, Pit-vipers, Opisthoglypha, and *Cnemidophorus*, all of which are plentiful in Yucatan, should not have crossed over into Cuba if a direct land-bridge had been available.

Unless this conclusion be accepted, we have to resort to violent interpretations. Either complete extinction all over North America, a measure which receives no support from actual distribution; or we must be prepared to assign to the Opisthoglypha a Cretaceous age, as a family not descended from North-American Colubrinæ; or, lastly, if we should insist upon the Opisthoglypha as a natural group, the only explanation would be a land-connection across the Equatorial Atlantic, which with shifting modifications is supposed to have existed from Lower or Mid-Cretaceous into at least the Oligocene epoch.

This bridging of the Atlantic is somewhat problematic. For our purposes we can discard the Cretaceous Brazil–Africa connection. Of more concern to periarctic distribution is the Europe–Greenland–North America continuity, which is supposed to have persisted well into the Tertiary period. But there was a third, more direct bridge, although one of a curious and mysterious structure, which by its several advocates is dimly described as composed of a shallow sea interspersed with many islands; or as a solid land-belt; or, lastly, as a long archipelago with a continuous coast. This mysterious structure is supposed to account for the unmistakable similarity between the now extinct Antillean and Mediterranean coral-fauna, Old-World and Antillean land-mollusca, &c. Obviously the corals require sea, the mollusca land. The apparent contradiction may be solved by the suggestion that there existed between Central America and the Mediterranean a sea (part of the Tethys of Suess and Ortmann, later their "Great Mediterranean"), shallow during the Oligocene epoch, studded with islands, bordered by continuous land in the South (Brazilia to West Africa, or later between N. South America and West Africa, part of the Mesozonia of Ortmann) and in the North (Western Europe to Appalachia). Subsequently the Tethys increased to a big "bay" in Mid-Atlantic, this bay extending, spreading south and north, drowning first the southern land-belt, driving the northern land farther and farther north, with the ultimate result of a junction of the South with the North Atlantic; in other words, establishment of the whole Atlantic.

Now these land-bridges, provided they existed long enough and at the right time and place, the Southern until at least the beginning of the Eocene, the Northern at least through the Oligocene epoch, would explain many a puzzle in geographical distribution; for instance, that of the Aglossa, Boas, *Podocnemis*, Amphisbænidæ, *Solenodon*. The Northern bridge would throw light upon the Anguidæ and upon *Spelerpes*, a large American genus with a solitary species in Sardinia and Italy.

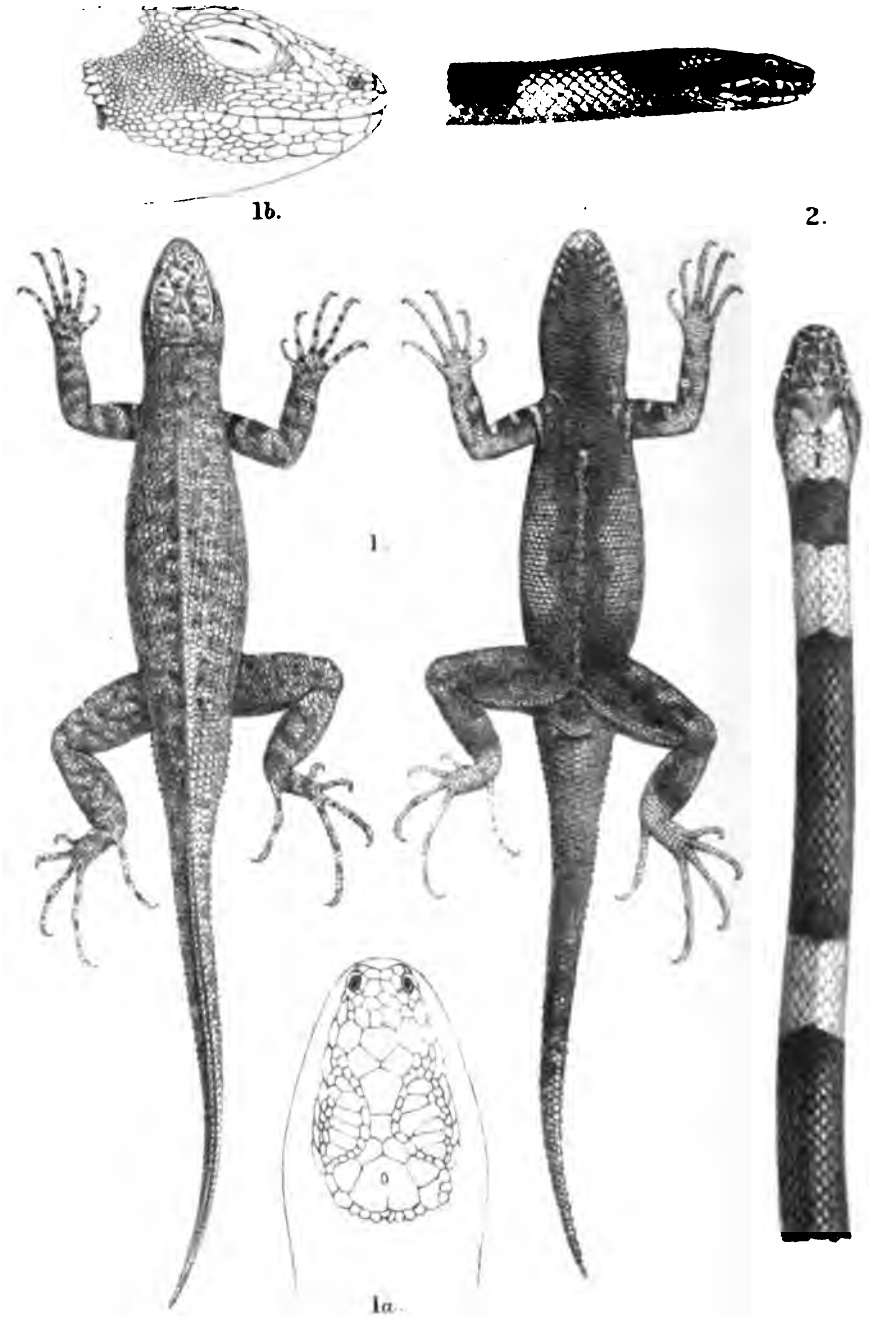
But this is at present a land of dreams. With more claim to reality, we can conclude that *Central America, although genetically part of the North-American continent, has received its dominant, most characteristic fauna from South America*, and this southern fauna has surged northwards chiefly to the east and west of the Mexican plateau.



J. Green del. et lith.

Bale & Danielsson L[td] imp.

1. ANOLIS GADOVII. 2. ANOLIS LIOGASTER.



J. Green del. et lith. Bale & Danielsson Ltd imp.

1. SCELOPORUS GADOVIÆ. 2. LEPTODIRA GUILLENI.

3. Descriptions of new Reptiles discovered in Mexico by Dr. H. Gadow, F.R.S. By G. A. BOULENGER, F.R.S., V.P.Z.S.

[Received May 17, 1905.]

(Plates VI. & VII.*)

ANOLIS GADOVII. (Plate VI. fig. 1.)

Head once and two-thirds as long as broad, slightly longer than the tibia; forehead concave; frontal ridges distinct, divergent; upper head-scales rugose, not keeled; scales on frontal ridges and supraorbital semicircles large, the latter in contact on the interorbital region; three large supraoculars, forming together a disk separated from the supraorbital semicircle by two series of small scales; occipital large, a little larger than the ear-opening, separated from the supraorbital semicircles by two series of small scales; canthal scales four, loreal rows six; six or seven upper labials to below centre of eye; ear-opening large, vertically oval. Gular appendage very large, extending far back on the breast; gular scales smooth. Body compressed; no dorso-nuchal fold. Dorsal scales small, smooth or faintly keeled, irregular, juxtaposed; lateral scales minute, granular; ventral scales larger than dorsals, smooth, juxtaposed. The adpressed hind limb reaches the eye; tibia as long as the distance between the end of the snout and the ear; digits moderately dilated; 20 lamellæ under phalanges II and III of the fourth toe. Tail feebly compressed, not crested, once and three-fourths length of head and body. No enlarged postanal scales. Greyish above, with black wavy and vermicular lines; two parallel black lines on each side from shoulder to hip; belly white; gular appendage bright red.

Total length	225 millim.	Fore limb......	37 millim.
Head	20 ,,	Hind limb ...	63 ,,
Width of head ...	12 ,,	Tail	145 ,,
Body	60 ,,		

This very distinct and handsomely marked *Anolis* is represented by a single male specimen, from Tierra Colorada, South Guerrero.

ANOLIS LIOGASTER. (Plate VI. fig. 2.)

Head once and a half as long as broad, longer than the tibia; forehead deeply concave; frontal ridges strong, short, divergent; upper head-scales smooth or feebly keeled; scales of the frontal ridges and supraorbital semicircles large, the latter in contact on the interorbital region or separated by one series of small scales; three large, smooth or faintly keeled, transverse supraocular scales forming a single longitudinal series, in contact with the supraorbitals or separated from them by one series of small scales; occipital larger than the ear-opening, separated from the supraorbitals by one or two series of scales; canthus rostralis sharp; canthal scales

* For explanation of the Plates, see p 247.

three; loreal rows five; six upper labials to below the centre of the eye; ear-opening rather small, vertically oval. Gular appendage very large, extending far back on the breast, in the male, absent in the female; gular scales feebly keeled. Body feebly compressed; no dorso-nuchal fold. Dorsal scales subrhomboidal, subimbricate, strongly keeled, passing gradually into the minute, granular scales of the sides; ventrals much larger than dorsals, rounded, imbricate, smooth. The adpressed hind limb reaches the eye or a litte beyond; digits moderately dilated; 16 lamellæ under phalanges II and III of the fourth toe. Tail scarcely compressed, twice as long as head and body. Male with enlarged postanal scales. Reddish brown above, with a paler broad vertebral stripe, widening on the nape; this stripe edged with dark brown in the female; lower parts golden, the gular appendage bright red.

Total length	150 millim.	Fore limb......	23 millim.
Head	16 ,,	Hind limb ...	37 ,,
Width of head ...	10 ,,	Tail	100 ,,
Body	34 ,,		

Two specimens, male and female, from Omilteme, Guerrero, 7600 ft.

The male is remarkable in the absence of the inner digit on the four limbs.

Allied to *A. nebulosus* Wiegm. Distinguished principally by the smooth ventral scales.

SCELOPORUS GADOVIÆ. (Plate VII. fig. 1.)

Head-shields smooth; frontal transversely divided, separated from the interparietal by a pair of frontoparietals; interparietal as long as broad; parietals small, one pair on each side; two canthal scales; five or six large transverse supraoculars, bordered inwards by one series of scales, outwards by one or two; five long pointed scales form a strong denticulation in front of the ear. Dorsal scales larger than ventrals, strongly keeled, pointed or shortly mucronate, forming oblique series converging towards the median line, passing gradually into the smaller scales of the sides; 73 to 77 scales between the interparietal shield and the base of the tail; 19 or 20 scales, taken in the middle of the back, correspond to the length of the shielded part of the head. Ventral scales small, smooth, bicuspid. 75 to 80 scales round the middle of the body. The adpressed hind limb reaches the ear; tibia as long as the distance between the end of the snout and the ear; the distance between the base of the fifth toe and the extremity of the fourth exceeds the distance between the end of the snout and the posterior border of the ear. 28 to 33 femoral pores on each side, the two series narrowly separated on the præanal region. Tail compressed; caudal scales a little larger than dorsals, strongly keeled, the two median upper series more strongly mucronate and forming a pair of serrated ridges. Male with slightly enlarged postanal scales. Greyish olive above, reddish on the sides, dotted with bluish

green; limbs with rather indistinct dark bars; throat and belly dark blue; a narrow whitish median ventral streak.

Total length	147 millim.	Fore limb......	32 millim.
Head..............	15 „	Hind limb ...	45 „
Width of head...	11 „	Tail	80 „
Body..............	52 „		

Two male specimens from a ravine near Mesquititlan, north of Chilpancingo, Guerrero.

This very remarkable species, which I take the liberty of naming after Mrs. Gadow, agrees with *S. pyrrhocephalus* Cope, in its distinctly compressed tail, but differs from it in having much smaller scales and more numerous femoral pores. No species of *Sceloporus* was hitherto known to have more than 25 femoral pores on each side.

LEPTODIRA GUILLENI. (Plate VII. fig. 2.)

Rostral twice and a half as broad as deep, scarcely visible from above; internasals a little longer than broad, little shorter than the præfrontals; frontal once and two-thirds as long as broad, a little longer than its distance from the end of the snout, a little shorter than the parietals; loreal as long as deep; one præocular, well separated from the frontal; two postoculars; a subocular below the præocular and another below the postoculars; temporals 1+2; eight upper labials, fourth and fifth entering the eye; five lower labials in contact with the anterior chin-shields, which are much shorter than the posterior. Scales in 23 rows. Ventrals 189; anal divided; subcaudals 71. Above with eleven dark brown areas separated by narrow greyish-white bands; snout, interocular region, and temples brown, back of head and nape bright red with a dark brown median line; a light, dark-edged streak along the upper lip; lower parts white, the ventrals with a brown spot on each side; subcaudals brown, edged with whitish.

Total length 530 millim.; tail 110.

A single female specimen from the Rio Balsas, Guerrero.

This species which, on the whole, is intermediate between *L. nigrofasciata* Gthr. and *L. personata* Cope, is named after Señor Don Manuel Guillen, Governer of the State of Guerrero, in recognition of valuable assistance rendered to Dr. Gadow.

EXPLANATION OF THE PLATES.

PLATE VI.

Fig. 1. ***Anolis gadovii***, sp. n., p. 245.
1 *a*. „ „ Upper view of head, ×2.
2. „ ***liogaster***, sp. n., p. 245.
2 *a*. „ „ Upper view of head, ×2½.

PLATE VII.

Fig. 1. ***Sceloporus gadoviæ***, sp. n., p. 246. Upper and lower views.
1 *a*. „ „ Upper view of head, ×2½.
1 *b*. „ „ Side view of head, ×2½.
2. ***Leptodira guilleni***, sp. n., p. 247. Upper and side views of head and anterior part of body.

4. On a Collection of Batrachians and Reptiles made in South Africa by Mr. C. H. B. Grant, and presented to the British Museum by Mr. C. D. Rudd. By G. A. Boulenger, F.R.S., V.P.Z.S.

[Received May 29, 1905.]

The collections made within the last two years in South Africa by Mr. C. H. B. Grant and presented to the British Museum by Mr. C. D. Rudd, the Mammals of which have already afforded matter for two papers by Messrs. O. Thomas and H. Schwann, published in these 'Proceedings,' included a good series of Batrachians and Reptiles, a list of which is here given. No new species were discovered, but the series is interesting for the sake of the localities, our knowledge of the exact distribution of these animals in South Africa being still very imperfect.

A list of the localities is here given:—

I. Cape.
- Durban Road, near Cape Town. This "Durban" is a town about 15 miles N.E. of Cape Town.

II. British Namaqualand.
- Port Nolloth, at mouth of Orange River.
- Klipfontein, a station on the railway between Port Nolloth and O'okiep, 54 miles from Port Nolloth. Altitude 3104 ft.

III. Zululand.
- Hluhluwe Stream, flows west into False Bay.
- Umfolosi Station, on the railway, about 5 miles north of Umfolosi River.
- Eshowe, about 30 miles inland from Coast and Umhalazi River. Altitude 1800 ft.
- Ngoye Hills, 15 miles E. of Eshowe, and 8 miles inland from Coast. Altitude 600–1000 ft.
- Sibudeni, about 60 miles inland from coast, at source of Umhlatuzi River. Altitude 3500–5500 ft.
- Jususie River, close to Sibudeni.

IV. Transvaal.
- Wakkerstroom, on the Natal border and at southern end of Drakenberg Range.
- Zuurbron, 20 miles East of Wakkerstroom.

BATRACHIA.

Aglossa.

1. Xenopus lævis Daud.

Durban Road, Umfolosi Station, Wakkerstroom,

The largest specimen (♀) measures 100 millim. from snout to vent.

In the present uncertainty as to the distinction of species in this genus, the distribution of *X. lævis* is difficult to trace. This species appears to be found all over South Africa where there is water, and it extends as far north as Angola to the West and Abyssinia to the East, the British Museum possessing specimens, which I cannot separate from the typical form, from Lake Mweru, Uganda, and Senafé.

Angola specimens (*X. petersii* Bocage), which have been referred either to *X. lævis* or to *X. muelleri* by Günther, by Peters, and by myself, cannot be separated, by any character that I can detect, from *X. lævis*. I have examined eight specimens, one from Benguella, received from Prof. Barboza du Bocage himself, five from Pongo Andongo, obtained by Dr. Ansorge, and two from Dr. Welwitsch's Angola collection. Bocage gives the length of the Angola specimens as not exceeding 65 millim. from snout to vent, but one of Welwitsch's specimens measures 80.

In the typical *X. lævis* from South Africa the subocular tentacle measures less than one-third the diameter of the eye, and is sometimes reduced to a mere tubercle, the inner metatarsal tubercle is very blunt and feebly prominent, never conical, and vomerine teeth are constantly absent.

The true *X. muelleri*, as described and figured by Peters in his 'Reise nach Mossambique,' vol. iii. (1882), has the tentacle more than half as long as the eye, the metatarsal tubercle more prominent, more conical than in *X. lævis*, and vomerine teeth, first noticed by Tornier, are often present. In addition to Mozambique, whence it was first described, this species is found in Nyasaland and on Zanzibar and the opposite coast.

To distinguish between *X. muelleri* and *X. lævis* is, however, not so easy as one might at first think, for the British Museum has received from Mr. C. S. Betton three specimens from hot springs near Lake Nakuro, British East Africa, which agree with the former in the prominent, conical metatarsal tubercle, and with the latter in the short tentacle and the absence of vomerine teeth.

X. clivii described from Erythræa by Peracca, and obtained in numerous examples at Addis Ababa and Ashoofi, Abyssinia, by Mr. E. Degen, agrees with *X. lævis* in the proportions, in the short tentacle, and in the absence of vomerine teeth, but is easily distinguished by the inner metatarsal tubercle being armed with a black claw, as in *X. calcaratus*, which inhabits Liberia, Lagos, Nigeria, Cameroon, the Gaboon, and the Congo. In the males of *X. clivii* the brown nuptial asperities, instead of being restricted to the inner side of the fore limbs, as in *X. lævis*, extend as a large patch on each side of the breast.

Two specimens from "West Africa," collected by Mr. Fraser, therefore probably from Nigeria or Fernando Po, which have been referred by Dr. Günther and by myself to *X. muelleri* in the British Museum Catalogue, agree with that species in the size of the eye, the length of the tentacle, and the presence of vomerine

teeth (five in number)*, with *X. clivii* and *X. calcaratus* in the presence of a metatarsal "claw." These specimens, the larger of which measures only 39 millim., no doubt indicate a distinct species, for which I propose the name *X. fraseri*.

PHANEROGLOSSA.

2. BUFO REGULARIS Reuss.

Umfolosi Station, Hluhluwe Stream, Ngoye Hills, Wakkerstroom.

3. BUFO GRANTI Blgr.

Durban Road, Klipfontein.

Since this species was described, in 1903, from numerous specimens obtained by Mr. Grant at Deelfontein, it has been rediscovered at Matjesfontein by Dr. W. F. Purcell, of the South African Museum. The male specimen which the British Museum has received from that institution measures 60 millim. from snout to vent and strikingly resembles a *Bufo viridis*. The interorbital space is as broad as the upper eyelid, the tympanum measures three-fifths the diameter of the eye, the first finger extends a little beyond the second, the tibio-tarsal articulation reaches the tympanum, and the subarticular tubercles under the toes are all single. The single male specimen found by Mr. Grant in a garden on Durban Road, near Cape Town, agrees very closely with the Matjesfontein Toad, but some of the subarticular tubercles under the toes are double. Another male, from Klipfontein, also has double subarticular tubercles.

4. BUFO ANGUSTICEPS A. Smith.

Durban Road.

Several specimens, the largest measuring 46 millim. from snout to vent. The first finger never extends beyond the second, the fold along the inner side of the tarsus is more or less distinct, and the subarticular tubercles of the toes are usually single, although there are occasionally two between the last phalanges of the fourth toe.

Bufo dombensis, from Dombe, Benguella, described by Barboza du Bocage in 1895 as a close ally of *B. angusticeps*, is more nearly related to Smith's *Bufo vertebralis*, which, following Günther, I have erroneously regarded as the young of *B. carens*. The examination of a small Toad found at Vredefort Road, Orange River Colony, by Major Barrett-Hamilton, and of which four specimens have been presented by him to the British Museum, has convinced me of my error. The breeding male, with large gular vocal sac, measures only 27 millim. from snout to vent, the female 35. In these specimens, the tympanum is close to the eye,

* The vomer is single in *X. lævis*, *muelleri*, and *clivii*, absent in *X. calcaratus*, *Hymenochirus*, and *Pipa*.

and may measure three-fourths its diameter; the parotoids are flat and very indistinct, broken up into several glands; the subarticular tubercles are double, and there is no trace of a tarsal fold. The limbs are shorter than in *B. carens* and the white rhomboidal spot on the vertebral line, which does not exist in *B. carens*, appears to be constant; black spots are always present on the belly.

5. Rana delalandii D. & B.

Durban Road.

6. Rana fuscigula D. & B.

Klipfontein.

7. Rana angolensis Bocage.

Eshowe, Sibudeni, Wakkerstroom.

The vocal sacs of the males form longitudinal folds on the sides of the throat.

8. Rana mascareniensis D. & B.

Sibudeni.

This species had not previously been recorded from South Africa. In the five specimens from Sibudeni the tibio-tarsal articulation reaches beyond the tip of the snout; a light vertebral stripe and a light line along the tibia are present.

9. Rana grayi A. Smith.

Durban Road, Klipfontein, Sibudeni, Ngoye Hills.

10. Rana fasciata Tsch.

Sibudeni.

The longitudinal folds and the dark stripes on the back are absent in the single specimen.

11. Phrynobatrachus natalensis A. Smith.

Sibudeni.

12. Arthroleptis wahlbergii A. Smith.

Sibudeni and Hluhluwe Stream. The British Museum has also received a specimen from Pietermaritzburg, through Mr. Quekett.

REPTILIA.

Chelonia.

1. Sternothærus sinuatus A. Smith.

Umfulosi Station.

A single half-grown specimen, the shell measuring 110 millim. As pointed out by me in 1896 *, this species is very variable and

* Ann. Mus. Genova, (2) xvii. p. 15.

to distinguish it from *S. nigricans* is not without difficulties. In this specimen the cusps in the upper jaw are absent, the posterior border of the carapace is very distinctly serrated, the intergular shield is twice as long as broad, the length of the outer border of the pectoral shield slightly exceeds that of the humeral, and the suture between the abdominal shields is shorter than the front lobe of the plastron. Head pale brown above, with black vermiculations, white beneath, with blackish spots; plastron yellowish brown, bordered with black.

2. Cinixys belliana Gray.

Umfolosi Station.

This species had not previously been recorded from South Africa. In the specimens collected by Mr. Grant the shields of the carapace are marked with black radiating streaks.

3. Homopus signatus Walb.

Klipfontein.

Lacertilia.

4. Lygodactylus capensis A Smith.

Ngoye Hills.

5. Pachydactylus bibronii A. Smith.

Klipfontein.

6. Pachydactylus mariquensis A. Smith.

Klipfontein.

7. Agama brachyura Blgr.

Klipfontein and Port Nolloth.

This species was established on a single female specimen labelled "Cape of Good Hope," from Sir A. Smith's collection. I have since examined four specimens collected at Deelfontein by Mr. Seimund, and presented to the British Museum by Col. Sloggett, and these, together with the six collected by Mr. Grant in British Namaqualand, enable me to give a revised description of this near ally of *Agama hispida*.

Head convex, subcordiform, as long as broad. Nostril not tubular, lateral, pierced just below the canthus rostralis in a convex nasal. Scales on anterior part of head smooth or rugose, sometimes feebly keeled, often trihedral on middle of snout, on back of head more or less strongly keeled, some erect and spinose; occipital enlarged; head about the ears and neck with short erect spines. Body strongly depressed, covered with irregular, imbricate, strongly keeled scales intermixed with strongly enlarged, trihedral, spinose ones; a small nuchal crest, sometimes continued along the body; ventral scales smooth or very feebly

keeled. Limbs moderate, with scales very unequal in size; hind limb reaching between the shoulder and the ear; tibia as long as the skull to occiput; fingers short, third longest; third and fourth toes equal, or fourth very slightly the longer, fifth not extending as far as first. Tail shorter or a little longer than head and body, cylindrical or slightly compressed, covered with strongly keeled scales. Male without gular pouch, with a single row of anal pores. Olive-brown or reddish brown above, with dark brown or blackish spots, the principal of which form a double series along the back, each pair separated on the vertebral line by a square or X-shaped or ∩-shaped yellowish marking; lower parts whitish or greyish, with a wide-marked grey or blackish network, which may disappear in adult males; the latter always have a bluish throat.

	♂. millim.	♀. millim.
Total length	235	160
Head	29	22
Width of head	28	22
Body	81	63
Fore limb	53	40
Hind limb	72	54
Tail	125	75

A. brachyura differs from *A. hispida* principally in the fourth toe not being shorter than the third and in the absence of strong keels on the ventral scales.

8. Agama armata Peters.

Hluhluwe Stream.

9. Agama atra Daud.

Klipfontein.

Both *A. micropholis* Matschie (Zool. Jahrb., Syst. v. 1890, p. 607), and *A. microterolepis* Blgr. (Ann. & Mag. N. H. [6] xvii. 1896, p. 22), from the Transvaal, must be added to the synonymy of this species.

10. Zonurus polyzonus A. Smith.

Port Nolloth, Klipfontein.

11. Pseudocordylus microlepidotus Cuv.

Wakkerstroom.

12. Chamæsaura anguina L.

Umfolosi Station.

13. Varanus albigularis Daud.

Umfolosi Station.

14. VARANUS NILOTICUS L.

Ngoye Hills, Sibudeni, Jususie Valley.

15. NUCRAS TESSELLATA A. Smith.

Klipfontein.

16. NUCRAS DELALANDII M.-Edw.

Sibudeni.

17. ICHNOTROPIS CAPENSIS A. Smith.

Umfolosi Station.

The parietal shields sometimes form a short suture separating the interparietal from the occipital. The scales on the preanal region are much smaller in females than in males.

18. SCAPTIRA KNOXII M.-Edw.

Port Nolloth.

19. SCAPTIRA CTENODACTYLA A. Smith.

Port Nolloth.

The femoral pores may number as many as 36 on each side.

20. MABUIA TRIVITTATA Cuv.

Wakkerstroom.

21. MABUIA VARIA Peters.

Klipfontein, Umfolosi Station.

22. MABUIA STRIATA Peters.

Hluhluwe Stream, Umfolosi Station, Sibudeni, Ngoye Hills, Zuurbron, Wakkerstroom.

23. MABUIA SULCATA Peters.

Klipfontein.

24. SCELOTES BIPES L.

Durban Road.

25. ACONTIAS LINEATUS Peters.

Port Nolloth, Klipfontein.

RHIPTOGLOSSA.

26. CHAMÆLEON QUILENSIS Bocage.

Jususie Valley.

27. CHAMÆLEON VENTRALIS Gray.

Port Nolloth.

OPHIDIA.

28. PYTHON SEBÆ Gm.

Umfolosi Station.

29. ABLABOPHIS RUFULUS Licht.

Sibudeni.

30. PSEUDASPIS CANA L.

Wakkerstroom.

31. DASYPELTIS SCABRA L.

Ngoye Hills.
Uniform brown (var. *palmarum* Leach). 23 scales across the body. Ventrals 218; caudals 75.

32. AMPLORHINUS MULTIMACULATUS A. Smith.

Wakkerstroom.
Uniform green, without spots, as in the specimens presented by Dr. Quain and mentioned in the British Museum Catalogue (iii. p. 125). Ventrals 138; caudals 76.

33. TRIMERORHINUS RHOMBEATUS L.

Durban Road, Wakkerstroom, Klipfontein.

34. PSAMMOPHIS SIBILANS L.

Umfolosi Station.
The single specimen falls under Division F of the British Museum Catalogue (iii. p. 163). Ventrals 165; caudals 97.

35. DISPHOLIDUS TYPUS A. Smith.

Sibudeni.
Green, the scales edged with black (Division D of British Museum Catalogue, iii. p. 189). Scales in 19 rows. Ventrals 174; caudals 119.

36. ASPIDELAPS LUBRICUS Laur.

Klipfontein.

37. DENDRASPIS ANGUSTICEPS A. Smith.

Ngoye Hills.

38. BITIS ARIETANS Merr.

Umfolosi Station, Hluhluwe Stream.

39. BITIS CORNUTA Daud.

Port Nolloth, Klipfontein.

40. BITIS CAUDALIS A. Smith.

Port Nolloth.

5. Some Notes upon the Anatomy of the Yellow-throated Lizard, *Gerrhosaurus flavigularis*. By F. E. BEDDARD, F.R.S., Prosector to the Society.

[Received May 17, 1905.]

(Text-figures 33–38.)

Apart from osteology * and a few scattered notes, which will be referred to in the course of the present communication, there does not appear to be a great deal known about the internal structure of *Gerrhosaurus*. Inasmuch as this Lizard is regarded, from the point of view of external characters and osteology, as being exactly intermediate between the Lacertidæ and Scincidæ †, it seemed to me interesting to attempt a criticism or confirmation of this view, while recording any new facts which an investigation of *Gerrhosaurus flavigularis* might bring to light.

Jugal Ligament.

Many, but not all, of the Lacertilia possess, as is well known, a jugal ligament, which Huxley compared to the bony lower temporal arcade of *Hatteria*. The exact relationships of this ligament have not, I believe, been described in some of the Lizards in which I shall now proceed to detail the arrangement.

It is possible to recognise several stages in the conditions of the jugal ligament, which may represent evolutionary stages, though it is, of course, not implied that the genera to be mentioned are genetically connected in the order named.

In *Iguana tuberculata* the ligament as a distinct structure is totally absent. On cutting through the skin covering the "cheek," the muscles and bones of this region of the skull are at once arrived at. It appeared to me, however, that the subcutaneous connective tissue, which is dense and white in most parts of the body, was rather denser and whiter in the region where the jugal ligament would be were it present. It is possible, in fact, that in this lizard an early stage is met with—that the ligament is not yet differentiated from the general connective tissue of the skin. On the other hand, it cannot be denied that the same fact may be explained on the theory that the ligament has disappeared. In any case, *Gerrhosaurus* offers an intermediate condition. In this reptile the ligament in question is anchored firmly to the quadrate behind, but in front it is not attached to the jugal bone but to one of the bony scales which cover the face in this region. That is to say, the ligament has not as yet completely detached itself from the skin. So, at any rate, the facts seem to indicate. It is important to notice in connection with the main object of the present communication, viz., to attempt to fix the systematic

* Siebenrock, Ann. k. nat. Hofmus. Wien, vii. 1892.

† Boulenger, Cat. of Lizards.

position of *Gerrhosaurus*, that this lizard agrees absolutely and in every detail, so far as the jugal ligament is concerned, with the skink *Eumeces*.

The final stage in the arrangement of the jugal ligament is shown in *Physignathus*. In this lizard the ligament is attached firmly to the bones at either extremity, and has entirely lost its presumably original connection with the skin. Moreover, in the last-named lizard, the ligament is divisible into two regions. There is, first of all, a stronger narrow ligament which occupies exactly the position of the bony quadrato-jugal bar in *Hatteria*, and above this and in part overlapped by it is a thinner but still stout sheet of ligament which entirely fills up the temporal vacuity.

This state of affairs does not exist at all in *Gerrhosaurus* and *Eumeces*. It is distinctly suggestive of the complete obliteration of the lower temporal vacuity in certain Vertebrates.

In view of the fact that bones in some cases can be shown to degenerate into ligaments, it is not certain that the stages sketched out above may not be read in the inverse order. For example, the lower part of the fibula is ligamentous in Birds; but it is not to be assumed that here there is anything but a degeneration of the bone into ligament. The facts which have been detailed above concerning certain Lizards do not, however, appear to me to point to a reduction from a state of affairs such as is found in *Hatteria*. If we were only acquainted with the condition observable in *Physignathus* and *Iguana*, such a view might indeed be held. The bone, it would be urged, has degenerated into ligament in the one case, and has finally disappeared in the other. But the conditions to be seen in *Gerrhosaurus* and in *Eumeces* would seem to negative such a supposition.

Peritoneal Folds and Cœlom.

Although the suspension of the alimentary tract and the other viscera contained in the cœlom is broadly like that of many other Lacertilia, there are some differences of detail which require attention.

In the female example the line of attachment of the oviducal membrane, which diverges laterally on each side, marks off sharply the posterior pigmented area of the cœlomic membrane from the anterior non-pigmented or less pigmented area. This is quite a common and well-known arrangement among the Lacertilia. The reason why I bring the matter forward here, is that *Gerrhosaurus* differs from *Eumeces*, where there is no such differentiation of pigmented and non-pigmented areas *, and because the pig-

* This is not, however, a distinctive mark of difference from the Scincidæ and of likeness to *Lacerta*. *Lacerta* shows this sharp demarcation; but there are varying degrees among the Scincidæ. In *Eumeces* there is hardly any pigmentation; in *Tiliqua scincoides* there is a moderate amount, but evenly spread through the body-cavity (in a male). In *Macroscincus cocteaui* (female), however, the oviducal membrane marks off two areas; but the posterior area is not so deeply pigmented as in *Gerrhosaurus*.

mented area in the male *Gerrhosaurus* is distinctly greater than in the female example of that lizard, and there is no conspicuous fold of membrane continued forward from the gonad duct to serve as a demarcation between the two areas in the latter.

The *suspensory ligaments of the liver* offer, as is well known, characteristic differences of arrangement in various Lacertilia. In both examples of *Gerrhosaurus* the falciform ligament of the liver is double posteriorly for about the last $\frac{1}{4}$ of the total length of the liver. This double region of the umbilical or falciform ligament is a tent-like structure; that is, the two separate membranes converge ventrally to be inserted in common on to the ventral median line of the parietes. A partial duplication of the umbilical ligament of this kind is not uncommon in the Lacertilia. It occurs, for example, in *Lacerta ocellata*. The double condition of the umbilical ligament in the Scincidæ, originally discovered by John Hunter * and subsequently more fully dealt with by myself † and Prof. Cope ‡, seems to be merely an exaggeration of this, the union of the two, posteriorly separate, umbilical ligaments being deferred until at or near the anterior extremity of the liver. Furthermore, all of the members of the family Scincidæ are not thus characterised; for in *Macroscinus cocteaui* the arrangement of the umbilical ligament is much like that of *Gerrhosaurus*. In the question of affinity, therefore, the disposition of these mesenteries is not decisive. There are, however, one or two other points to be noted. In the first place, in *Eumeces algeriensis* both the umbilical ligaments are thickly invaded by muscular tissue, especially the left-hand ligament. This is also noticeable in *Macroscincus*, though to a much less extent; and it will be remembered that *Macroscincus cocteaui* is a much larger lizard than is *Eumeces algeriensis*, so that size in this case has nothing to do with the development of thickness and muscularity in the umbilical ligaments. It is plainly therefore of importance to note that in *Gerrhosaurus* these ligaments are not obviously muscular at all.

In the accompanying figures (text-figs. 33, 34) of the ventral surface of the liver in *Gerrhosaurus* two other facts may be pointed out. In the first place, there are traces of a membrane which runs obliquely forward and ends in a notch in the left border of the liver. As this white seam (*b* in text-figs. 33, 34) is much better developed in one example than in the other, I take it to represent a rudimentary structure, and it may represent the original course of the umbilical vein and thus correspond to a similar trace which Hochstetter has lately described § in the Blind Worm (*Anguis fragilis*).

* Essays and Observations, revised by Richard Owen, London, 1861, vol. ii. p. 369. "The liver [of *Tiliqua*] is attached forwards by two membranes, one to each lobe, which unite at top."

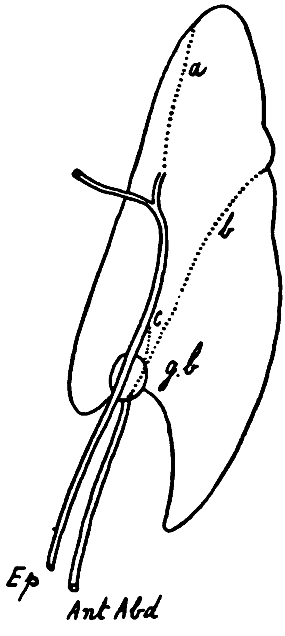
† P. Z. S. 1888, p. 98.

‡ Proc. Acad. Sci. Philadelphia, 1896, p. 308.

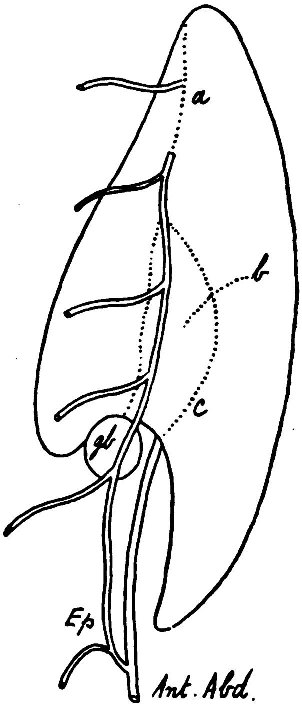
§ Morph. Jahrb. xix. Taf. xvi. fig. 18; but the course of the seam is different in the two cases.

The second point concerns the relationship of the two umbilical ligaments to veins entering the liver. A dissection of both specimens of *Gerrhosaurus* shows that the anterior abdominal vein enters the liver in the region of the left umbilical ligament (*c* in text-figs. 33, 34), and that the epigastric vein is similarly connected with the right umbilical ligament. Precisely the same relationship holds for *Macroscincus cocteaui*. Inasmuch as the anterior abdominal vein joins the portal vein, the latter might

Text-fig. 33.



Text-fig. 34.



Text-fig. 33.—Liver of *Gerrhosaurus flavigularis*, ventral aspect.

a. Attachment of umbilical ligament; *b*. Seam indicating course of embryonic umbilical vein (?); *c*. Left half of umbilical ligament; *Ant.Abd*. Anterior abdominal vein; *Ep*. Epigastric vein; *g.b*. Gall-bladder.

Text-fig. 34.—Liver of a second example of *Gerrhosaurus flavigularis*, ventral aspect. Lettering as in text-fig. 33.

be regarded as fixing this point were it not for the conditions observable in *Macroscincus cocteaui*. In that lizard the portal vein, immediately in front of the region where it has, as have the portal veins of other lizards, a spiral twist, divides into two branches, which enter the liver in a line with each part of the divided umbilical ligament. As to the relationship between the divided

umbilical ligaments and blood-vessels, it is noteworthy that in *Eumeces algeriensis* two hepatic arteries are associated each with one of the two umbilical ligaments of that lizard.

Gastrosplenic Omentum.—This mesentery is very conspicuous in *Gerrhosaurus.* It stands out as a free fold with the following relations:—It arises from the stomach close to the pylorus and passes obliquely downwards supporting the posterior extremity of the spleen, the rest of which lies upon the mesogastrium; it is finally attached to the median dorsal line of the body-wall on a level with the left ovary.

This arrangement is practically repeated in *Macroscincus*, where, however, owing to the position of the viscera, the omentum is shorter, but very strong and fibrous. Moreover the spleen does not even reach, let alone hang over, the edge, as is the case with *Gerrhosaurus.* In *Eumeces*, however, the gastrosplenic omentum is identical in its relations with that of *Gerrhosaurus*, save that it is a little less pronounced as a free fold. I am not describing here a state of affairs which is merely Lacertilian; for in *Tupinambis* the course and relations of the apparently homologous fold are different and do not involve the spleen.

Hepato-pulmonary Ligaments.—*Gerrhosaurus* agrees with the majority of Lizards in that the right lung is suspended by two mesenteries, viz., the hepato-pulmonary and dorsal pulmonary. It is noteworthy that the latter mesentery in the case of both lungs extends to the very tip of the organ; whereas in *Eumeces* the mesenteries in question do not reach the extremity of the lungs. This is not, however, a characteristic of the Skinks as opposed to *Gerrhosaurus*, for in *Tiliqua* the membrane is co-extensive with each lung as in *Gerrhosaurus.* Mr. Butler * observes that "certain Scincoid lizards are as to the relations of their right lungs and liver intermediate between the Teiidæ and other Lizards." My own knowledge of the family Scincidæ enables me to confirm Mr. Butler; but his accurate statement requires expansion †. In *Eumeces*, *Macroscincus*, and *Tiliqua* there is, in fact, attached to the right lung a pulmo-hepatic ligament which is not so extensive as in, *e. g.*, *Gerrhosaurus.*

In *Macroscincus cocteaui* this membrane extends rather more than halfway down the lung and ends off upon the dorsal pulmonary ligament, necessarily running in this region in a direction nearly at right angles to the longitudinal axis of the lung. Whereas in *Gerrhosaurus flavigularis* the two pulmonary membranes join behind the right lung ‡, in both specimens which I examined.

The fact that there is no ligamentous interval between the

* "On the Subdivision of the Body-cavity in Snakes," P. Z. S. 1892, p. 481.

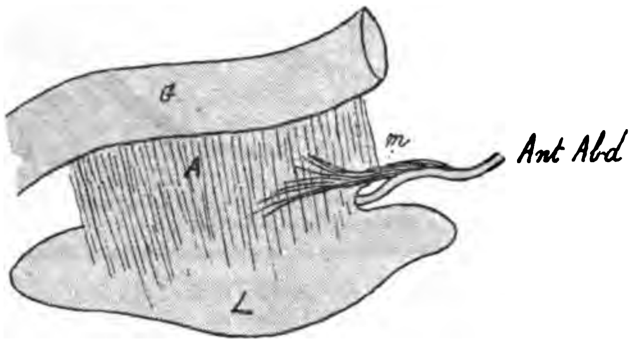
† And has also been expanded by Hochstetter quoted below.

‡ Hochstetter (Morph. Jahrb. xxvii. p. 292) figures the same membranes in some other Skinks, where they appear to agree with those of the forms studied by myself. He says, however, of *Gerrhosaurus madagascariensis* that the "caudal end of the right lung commences to be isolated from the ligamentum hepato-cavo-pulmonale." It is not so in *G. flavigularis.*

prolonged right lobe of the liver and the gonad, both male and female, does not bear upon the question of the affinities of *Gerrhosaurus*. For among the Skinks these organs may be in contact or separated by a ligamentous interval.

Muscular fibres in Mesenteries.—As is the case with other Saurians, *Gerrhosaurus* has bands of unstriped muscle in several of the mesenteries. The most important of these is a bundle of muscular fibres which accompanies the anterior abdominal vein (text-fig. 35, *m*) and runs into the gastro-hepatic ligament. It is a thick bundle of fibres, but after traversing the gastro-hepatic ligament for about half its extent it fans out into a fine bundle, the individual fibres of which hardly reach the stomach. This bundle is represented in many lizards. But the conditions observable in *Gerrhosaurus* throw no light upon the affinities of

Text fig. 35.



Gastro-hepatic ligament of *Gerrhosaurus flavigularis*, showing course of muscular bundle.

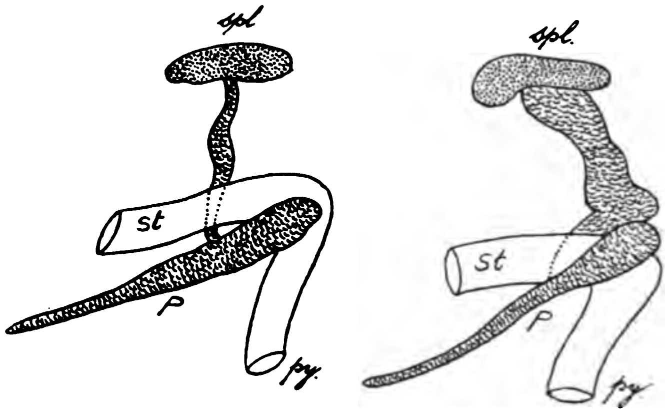
A. Gastro-hepatic ligament; *Ant.Abd.* Anterior abdominal vein; *G*. Stomach; *L*. Left lobe of liver; *m*. Muscular band.

that lizard. For though it differs from the arrangement found in the Scincidæ, it shows no likeness to what is found in *Lacerta ocellata*. In *Eumeces*, *Macroscincus*, and *Lacerta ocellata* the bundle of fibres is continued without fanning out to the stomach, where it forms a close investment of that organ for the greater part of its extent in *Macroscincus*. Inasmuch as both specimens of *Gerrhosaurus* were identical in the characters of this muscle, it may, I think, be assumed that its condition is typical of the species.

Pancreas.—The pancreas of *Gerrhosaurus* (text-fig. 36, p. 262) differs from that of *Lacerta ocellata* in the comparative stoutness of the branch which goes to the spleen. It is, in fact, like Leydig's figure of the pancreas of *Lacerta agilis*, expanding when it reaches the spleen. The pancreas of *Gerrhosaurus* furthermore differs from that of *Lacerta* (at any rate *ocellata*) in that there is a

patch of the gland on the dorsal side of the pyloric angle from which the splenic limb arises, and which is continuous beneath the end of the stomach with the main body of the pancreas. In *Lacerta ocellata* the splenic limb arises from the main lobe of the pancreas further towards the gall-bladder. In these points the

Text-fig. 36.



Pancreas of *Lacerta ocellata* (left-hand figure) and of *Gerrhosaurus flavigularis* (right-hand figure).

P. Pancreas; *py.* Commencement of intestine; *spl.* Spleen; *St.* Stomach.

pancreas of *Gerrhosaurus* agrees with that of the Skinks, in which, however, there is a tendency towards an enlargement of the dorsal lobe of the pancreas and a disappearance of the splenic lobe. I could not detect the latter in *Macroscincus*, and it was very thin in *Tiliqua*.

Arterial System.

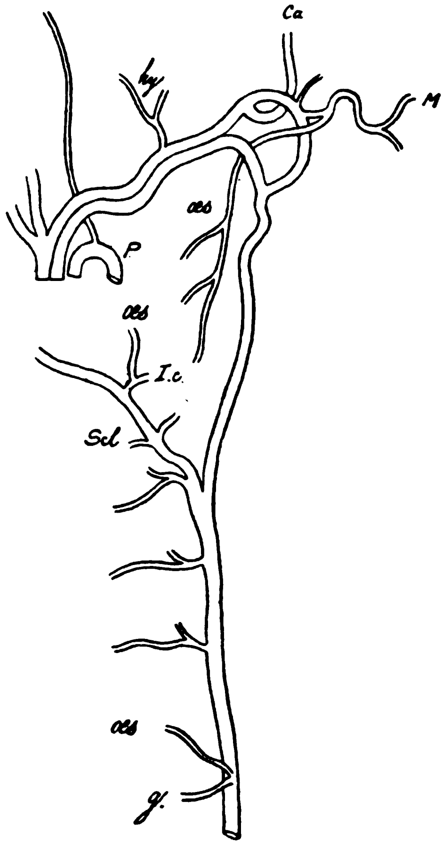
As one of the two specimens of *Gerrhosaurus flavigularis* which I have dissected was successfully injected, I am able to give some account of the arterial system, dealing particularly with those points which vary among the families of Lacertilia. The heart has the usual, but not universal, tag tying the apex of the ventricle to the pericardium. The pericardium extends forward beyond the trifurcation of the arteria innominata.

A pair of arteries exist of very fair size, running one on each side of the trachea in the position occupied by the carotids in many Vertebrates, and they are like them quite close to the trachea. These arteries have, however, nothing whatever to do with the carotids. They are branches of the pulmonary arteries (*P*, text-fig. 37), and the existence of these arteries in what appears to be an unexpected place is possibly indicative of a former forward extension of lung-tissue.

The branches of the carotid arch differ slightly from those of

some other Lizards, though they agree, as might be expected, in their main features. The first branch given off is a hyoid (*hy*, text-fig. 37), which supplies the hyoid region generally; I have not followed its branches minutely. In this region the carotid is in close contact with the systemic arch. Further dorsally they part company, and, shortly after this separation has occurred, the

Text-fig. 37.



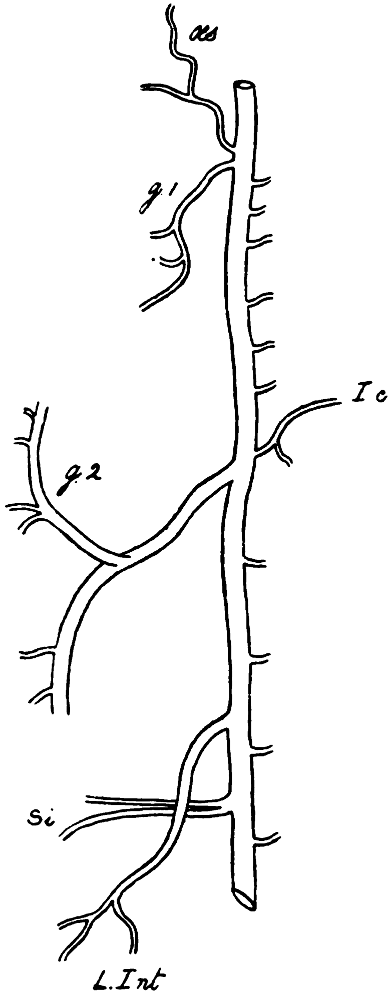
Aortic arches and first part of dorsal aorta of *Gerrhosaurus flavigularis*.

Ca. Carotid; *g.* Gastric; *I.c.* Vertebral artery; *hy.* Hyoid artery; *M.* Muscular twig; *œs.* Œsophageal branches; *P.* Pulmonary arch; *Scl.* Subclavian.

main trunk of the carotid arises. The trunks are here so twisted that the carotid stem is given off posteriorly and dives under the carotid arch to reappear on its anterior face. The rest of the carotid arch is to be regarded as ductus Botalli. From this section arise two arteries: the first is a small muscular twig; the

second is an important trunk which divides into two branches. One of these supplies the muscles of the shoulder-region (*M*); the

Text-fig. 38.



Abdominal region of aorta of *Gerrhosaurus flavigularis*.

g[1], *g*[2]. Gastric arteries; *I.c.* Intercostals; *L.Int.* Artery of large intestine; *œs.* Œsophageal artery; *Si.* Artery of small intestine.

other has a recurrent course and dives through the ring formed by the carotid and systemic arches to supply the œsophagus (*œs*).

The left systemic arch gives off no branches at all that I could discover.

From the *right systemic arch* (which joins the left at about the commencement of the lung) the two *subclavians* (text-fig. 37, *Scl.*, p. 263) are given off, nearly, if not exactly, opposite to each other. In front of this arises the *vertebral artery* (*I.c.*), which gives off an œsophageal branch before plunging into the thickness of the parietes. Behind the vertebral artery commences the series of intercostals. The first *intercostal artery* arises just before the junction of the two aortæ. It gives off a branch to the œsophagus. The next two intercostals have also œsophageal branches; but it is to be noted that in all these the right intercostal alone has this œsophageal branch. The left has none. The remaining intercostals have no œsophageal or gastric branches. Their arrangement is peculiar and agrees with that of the Skinks; it differs from that of some other Lizards.

In *Tropidurus hispidus*, for example, the regularly paired intercostals emerge from the dorsal aorta close to the articulation of successive vertebræ, and plunge at once into the thickness of the parietes.

In *Gerrhosaurus* the intercostal arteries emerge from the aorta at about the middle of each vertebra. In many cases, and the arrangement is roughly alternating, the intercostal of one or both sides divides at once into two branches; one of these plunges at once into the thickness of the parietes. The other passes obliquely forwards and runs superficially in close relation to a rib. This, however, only occurs in the thoracic region, not in the lumbar.

Precisely the same disposition of vessels is found in *Eumeces* and some other Skinks, and the fact is a bond of union between the Gerrhosauridæ and Scincidæ.

The next artery to arise from the aorta is a gastro-œsophageal (text-fig. 37, *œs*, *g*, p. 263, and text-fig. 38, *œs*, g^1, p. 264), which divides at once into a thin forwardly directed œsophageal, and a stout backwardly directed gastric. Between this and the large gastric artery (text-fig. 38, g^2) are 6 pairs of intercostals. Two pairs intervene between this artery and that of the large intestine, and one pair between the latter and the artery of the small intestine.

The ovarian and oviducal arteries present some features which are worthy of note. There are three pairs of oviducal arteries which are not symmetrical. The first of these is really mainly an ovarian artery, which gives off a thin and slender oviducal branch running along the anterior section of the oviduct. The two remaining oviducal arteries arise in common with an intercostal. They lie in front of the rectal artery.

Venous System.

Although the venous system of neither of the examples at my disposal was injected, most of the veins were beautifully displayed by their own turgescence.

There are many differences in detail between the venous system of this lizard and that of other genera.

Vena cava posterior.—It is interesting to note that *Gerrhosaurus* agrees with *Tiliqua* in that the left vena cava posterior is very much thinner than the stout right vein. This is another of those numerous though individually perhaps small points of likeness between the genus whose anatomy is dealt with in the present communication and the Scincidæ. As in *Tiliqua* also *, the left cava or vena renalis revehens lies to the left side of the mesorectum and the right vein to the right side of that mesentery. The left vena revehens is large where it receives the three or four veins arranged in a fan-like fashion from the left ovary; behind this point it dwindles immediately but can be easily traced to the kidney, where it becomes enlarged at its junction with the right vena renalis revehens.

The left vena renalis revehens receives two intercostal veins before the ovarian veins join it, and on the right side also I observed two intercostals. I could only observe one, and that a slender, oviducal vein joining the left vena renalis revehens. I feel convinced, however, that no veins from the oviducts join the afferent renal veins, as is often the case in Lizards. The reason for this in the present species may be that the kidneys are unusually far back.

Afferent Renal Veins.—The caudal vein reaches the kidneys as an undivided vein. It runs between them and receives a cloacal vein before dividing. Immediately after division each half receives another cloacal vein. The cloacal artery runs exactly at the point of division between the two afferent renals. At about the end of the first third of the kidney each renal afferent vein turns at right angles and runs superficially over the kidney, giving off a large branch to the kidney itself at about the middle of the transverse diameter of that organ. There is no sign of any forward continuation of the renal afferent vein beyond the anterior border of the kidney such as occurs in *Chamæleon* and *Pygopus* †.

Where the renal afferent vein reaches the border of the hind leg it receives three veins, two from the hind limb and one from the median dorsal parietes. It there runs directly forwards parallel with the kidney, and on a level with the anterior end of that gland receives the femoral vein, and a small parietal on the opposite side which crosses the epigastric artery. The vein then continues its straight course forward, and before bending inwards and downwards to follow closely the inner margin of the fat-body gives off a short forwardly directed branch, which appears to me to be the equivalent of the lateral abdominal vein of other Lizards. Its shortness in *Gerrhosaurus* contrasts with its length in *Tiliqua*.

Hepatic Portal Veins.—The mode of entrance of the conjoined intestinal portal and anterior abdominal and of the epigastric vein

* See Beddard, P. Z. S. 1904, vol. i. p. 445, fig. 93.
† See P. Z. S. 1904, vol. ii. p. 15, fig. 4.

has already been noted. The epigastric springs from the anterior abdominal some way behind the liver (text-fig. 34, *Ep.*, p. 259), and running along the umbilical ligament disappears in the substance of the liver some way behind the anterior end. It is reinforced by the usual branches from the median ventral parietes. These vary in number in what appears to me to be a remarkable way. In one specimen repeated examination has only enabled me to ascertain the presence of a single *ventral parieto-hepatic* vessel, which joins the epigastric at about the middle of the liver. In a second specimen, on the other hand, there were four of these ventral parieto-hepatic vessels (*cf.* text-figs. 33 and 34, p. 259). I am disposed to think that the fluctuation in number of these blood-vessels is related to fluctuation in the number and size of the dorsal parieto-hepatic veins. These differed in the two specimens which I have dissected, though not quite to so great an extent as the ventral parieto-hepatic veins. In the specimen with but one ventral parieto-hepatic vein, the *dorsal parieto-hepatic* veins were as follows:—a large vein accompanies the anterior edge of a fold of membrane which in this, as in many lizards, runs obliquely and binds the end of the right lobe of the liver to the parietes. This vein runs superficially for a short distance anteriorly alongside the aorta on the right side, and is clearly a fragment of the right posterior cardinal. It reaches the parietes on a level with and outside of one intercostal artery and disappears from view to the inside of the next intercostal artery in front; it resembles a large superficially running intercostal vein. Besides this there are three other dorsal parieto-hepatic veins lying behind it. In the second specimen, with numerous ventral parieto-hepatic veins, I could find only three dorsal ones; and the first of these was by no means so large as in the first described individual.

I could find only one *gastro-hepatic portal*, which was anterior in position.

6. On two Points in the Anatomy of the Lacertilian Brain. By F. E. BEDDARD, F.R.S., Prosector to the Society.

[Received May 17, 1905.]

(Text-figures 39 & 40.)

(1) *Note on the Cerebellum in* Varanus exanthematicus.

In the account of the Lacertilia in Bronn's 'Thierreichs' * the following statement is made concerning the cerebellum of *Varanus*:—"Das Cerebellum oder das Hinterhirn ist gewöhnlich ein unpaarer, dünner, steil und hoch aufsteigender Körper, der seitlich mit der Medulla oblongata fest zusammenhängt. Bei

* Bd. vi. p. 714.

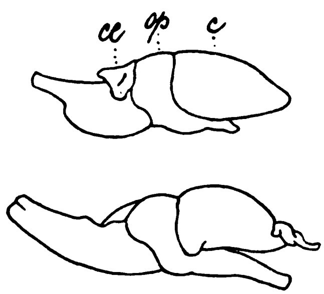
manchen Gattungen, z. B., bei *Varanus*, *Iguana*, ist es nach den Angaben von Stannius zwar dünn, aber schildförmig, vorne concav, hinten convex und zeigt Andeutungen einer Sonderung in eine mittlere und zwei seitliche Erhabenheiten, durch sehr schwache Vorragungen, zwischen denen Spuren von Furchen liegen."

It seems plain from the above account that the cerebellum of *Varanus* is considered to be like that of *Iguana*, and, presumably, of other Lacertilia.

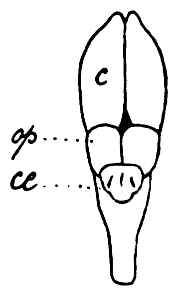
In one of the most recent works dealing with the brain of the Sauropsida, the Catalogue of the Museum of the College of Surgeons *, there is a description of the brain of *Varanus* and some incidental references to the brain in the Lacertilia. Of the brain of *Varanus* it is remarked that "the cerebellum is of moderate dimensions and has the plate-like form usual among Reptiles." Elsewhere (p. 110) it is said that "the reptilian brain is narrow . . . . and, except in swimming forms, with insignificant cerebellum." I have examined this specimen myself and agree with the description. None of these statements, as I think, does justice to the cerebellum of *Varanus exanthematicus*, which is not at all like that of *Iguana*, has not a plate-like form, and is not insignificant—comparatively speaking, at any rate.

The accompanying figure shows the characteristics of the

Text-fig. 39.



Text-fig. 40.



Text-fig. 39.—Lateral view of brain of *Varanus exanthematicus* (upper figure) and of *Tupinambis nigropunctatus* (lower figure).

Text-fig. 40.—Dorsal view of brain of *Varanus exanthematicus*.

c. Cerebrum; *ce*. Cerebellum; *op*. Optic lobes.

cerebellum of the Teguexin Lizard (text-fig. 39), which appears to me to be quite typical of the Lacertilia and to bear out the above quoted statements. It is a plate-like disc convex posteriorly, which as it were lies up against the optic lobes and is propped up

* Descriptive and Illustrated Catalogue of the Physiological Series contained in the Museum of the Royal College of Surgeons of England, vol. ii. p. 113 (2nd ed.).

by them. It is faintly grooved in the middle line and laterally on each side is a flattened process extending backward rather beyond the rest of the cerebellum. Its insignificant proportions are shown by the fact that the transverse (antero-posterior) diameter of this thin plate is 2 mm., while the corresponding measurement of the optic lobe is 8 mm.

As will be seen from text-figs. 39, 40 (p. 268), the cerebellum of *Varanus exanthematicus* is a much more important structure. Not only the actual but the relative size of the cerebellum is greater. The corresponding measurements to those given above for *Tupinambis* are for *Varanus*—diameter of cerebellum 4·5 mm., diameter of optic lobes 4·5 mm. They are thus equal.

The difference in dimensions between the cerebella of the two Lacertilia is due to the exaggeration in *Varanus* of the boss-like eminence upon the cerebellum of *Tupinambis* and *Iguana*. Not only is the cerebellum of *Varanus exanthematicus* much greater in bulk than that of *Tupinambis* or *Iguana*, but it is more complicated in structure owing to furrows.

The dorsal furrow, continuous with that dividing from each other the corpora bigemina, is more deeply marked in *Varanus* and more definitely circumscribed than in *Tupinambis*; in *Iguana* I did not find any traces of it. In the second place, the cerebellum of *Varanus exanthematicus* has an equally deeply marked lateral furrow, which runs obliquely upwards and forwards. Thirdly, the lateral process of the cerebellum is much more sharply marked off from the cerebellum itself than in *Tupinambis*, and runs downwards rather than backwards, thus distinctly suggesting the flocculus in the cerebellum of the higher forms. It is, indeed, not at all unlike the cerebellar flocculus in Alligator.

It is plain therefore that the cerebellum of this Lizard is not "a mere transverse plate," but an organ of some dimensions, and, indeed, not very far, in point of relative size, from that of the Crocodilia.

A large cerebellum has been associated in reptiles with the swimming habit. And it is true that the Monitor Lizards are often largely aquatic in habit. Curiously enough, however, the present species, with its large cerebellum, is stated by Dr. Günther* not to take to the water.

More likely, as it appears to me, is this advance in structural complexity of the brain to be associated with the not only isolated but high position which the Monitors occupy among the Lacertilia.

(2) *On the Cerebral Hemispheres in* Tropidurus hispidus.

I imagine that I am right in believing that the brain of this Iguanoid Lizard has not up to the present been submitted to anatomical examination. I am able, therefore, to add a fact of

* "On the Anatomy of *Regenia ocellata*," P. Z. S. 1861, p. 60.

some little interest to what is already known about the Lacertilian brain, as a result of the examination of two brains of this Lizard. In the Lacertilian brain generally, so far as my own knowledge and the inspection of published figures* enable me to state, the optic lobes lie behind the cerebral hemispheres, the furrow between them being practically vertical; there is, in fact, no trace of an overlap of the corpora bigemina by the hemispheres. In the Chelonia, on the other hand, it has been recognised that some forms show an overlap of the corpora bigemina by the cerebral hemispheres.

I have found this lobe very obvious in a brain of the large *Testudo vicina*, the vascular system of which I have recently described†. The overlap, however, is lateral and not dorsal. It is quite different with *Tropidurus*. There is a very distinct overlap of the corpora bigemina by the hemispheres dorsally. The corpora bigemina are thus partly hidden when the entire brain is viewed on the dorsal aspect.

A comparison of the measurements of the brain in this species and in *Iguana tuberculata* seems to throw some light upon the causation of this overgrowth of the cerebral hemispheres over the corpora bigemina dorsally.

The following are the measurements to which I desire to refer:—

	Iguana. mm.	*Tropidurus.* mm.
Length of brain to end of cerebellum ...	16	11
Length of cerebral hemispheres	9	6
Breadth of cerebral hemispheres	11·5	6·5

It will be observed, from a comparison of these figures, that the proportions between the total length of the brain in the two Lizards, and both the breadth and length of the cerebral hemispheres, are about equal. It therefore results that the overlap of the hemispheres in *Tropidurus* is rendered necessary by the skull formation and consequent lack of room for increased lateral growth of the hemispheres. By growing over the corpora bigemina, the hemispheres have been able to attain to the proper size necessary to the equilibrium of their possessor.

These considerations may be regarded, perhaps, as discounting the morphological importance of the partial covering over of the corpora bigemina by an extension backwards of the cerebral hemispheres.

Nevertheless, it is impossible to overlook the fact that there is an approximation in the brain of this Lizard, to whatever cause it may be due, to those of higher Vertebrates.

* See Bronn's Klassen u. Ordnungen des Thierreichs, Bd. vi., and Meyer, Zeitschr. wiss. Zool., Bd. lv. (1893).

† *Suprà*, p. 67.

7. On new Coleoptera from South Africa collected by Dr. H. Brauns and others—*Serricornia*, *Endomychidæ*, *Erotylidæ*. By H. S. Gorham, F.Z.S.

[Received May 19, 1905.]

This paper is a sequel to those published by me in the 'Annals and Magazine of Natural History' for 1900–1901. The material dealt with is similar in character to that contained in the collections sent to me by Mr. G. A. K. Marshall, but is without Coccinellidæ or Languriidæ. The publication of the paper has unfortunately been much delayed, owing to domestic reasons.

The Cleridæ are particularly well represented and indicate a very rich fauna in this subfamily as well as in the Melyridæ. *Hedybius* represents the European *Malachius*, and is evidently (with its allied genera) as rich in species.

Telephoridæ.

Telephorus viridescens Fab.

Telephorus viridescens Fab. Syst. Eleuth. i. p. 295 (*Cantharis*).

Hab. Willowmore, Uitenhage, Cape Colony (*Brauns*).

In the Munich Catalogue this species is given as a synonym of *Cantharis smaragdulus* Fab. Spec. Ins. p. 259, a Brazilian insect; but Fabr. *loc. cit.* gives "Cap bon. spei" as the locality of the *Cantharis viridescens*, with which my specimens agree very well.

Telephorus incisus Wied. Zool. Mag. ii. p. 71.

Hab. Algoa Bay, Cape Colony (*Brauns*). 2 examples.

Smaller than *T. viridescens*, with a thoracic vitta from the front to the hind margin and without spots on the sides or at the base; elytra less green, of a dull grey-black.

Telephorus zonatus Gemm. Cat. Col. p. 1674.

Telephorus vitticollis Bohem. Ins. Caffr. i. 2, p. 453, nec Ménétr. Cat. Rais. p. 162.

Hab. Algoa Bay, Cape Colony (*Brauns*). 1 example.

Described by Bohem. *loc. cit.* from "Limpopo" R., Caffraria.

Telephorus bivittatus Fab.

Nec *T. bivittatus* Mars.

Hab. Algoa Bay, Cape Colony (*Brauns*). 1 example.

Telephorus nigrinus Bohem. Ins. Caffr. i. 2, p. 457 (*Cantharis*)?

Hab. Algoa Bay, Cape Colony (*Brauns*). 2 examples.

In one of the two examples sent the thorax is nearly twice as wide as long, in the other example (which, from the length of its antennæ, appears to be a male) it is quadrate. This seems to me to agree with the insect described by me (Ann. & Mag. N. H. 1901,

vii. p. 351) as *T. teter* from Natal. From so few examples it is impossible to say whether these two pertain to one or two species; or what is the sex of the specimen with transverse thorax, which is also more shining and has shorter antennæ. I incline to the belief that they represent two species, the latter being referable to *C. nigrina* Bohem.

CLERIDÆ.

EUCYMATODERA Schenkling.

Eucymatodera Schenkling, Ann. Mus. Civ. Genova, 1899, p. 333; Genera Ins. fasc. xiii. p. 19 (1903).

EUCYMATODERA CINGULATA Klug, Cler. p. 273 (*Tillus cingulatus*).
Hab. Algoa Bay.

EUCYMATODERA HOTTENTOTA Knw. Ann. Soc. Ent. Belg. p. 463 (1893); Schenk. *l. c.* p. 20.
Hab. Willowmore, Cape Colony (*Brauns*).

CYLIDRUS Lat.

Cylidrus Schenk. Genera Ins. fasc. xiii. p. 5.

CYLIDRUS BALTEATUS Klug, Cler. p. 263.
Hab. Bothaville, Orange R. State (*Brauns*).
I had not seen this from S. Africa before.

GYPONYX Gorham.

Gyponyx Gorham, Ann. Mus. Civ. Gen. 1883, p. 604; Schenk. *l. c.* p. 45.

GYPONYX CHINENSIS Fab.
Gyponyx marmoratus Klug, Cler. p. 308 (*Clerus*), notâ p. 379.
Hab. Bothaville, Orange R. State (*Brauns*).

GYPONYX RETROCINCTUS Chevr. Rev. Mag. Zool. p. 283 (1874).
Hab. Sunday River, Cape Colony (*Brauns*).

GYPONYX ALGOENSIS, sp. n.
Oblongus, subparallelus, piceo-brunneus, nitidus; elytris basi dilutioribus, ultra medium fascia undulata et apice albis. Capite crebre prothorace parce punctatis, hoc pernitido, antice tenuiter constricto, postice coarctato; antennis et palpis rufo-piceis; elytris usque ad fasciam grosse seriatim punctatis, inde ad apicem fere lævibus; pedibus piceis, tarsis dilutioribus, metasterno punctato. Long. 11–14 *millim.*
Hab. Algoa Bay (*H. Brauns*).
The general colour of this species is dark pitchy brown, the antennæ, palpi, tarsi, and the base of the elytra nearly as far as the white fascia are rufo-piceous, the elytra are blackish in an

indefinite way just before the very definite white fascia; this is narrowly interrupted at the suture; the apex is white, but with a fine blackish margin; the space between the fascia and the apex is very obsoletely punctured, as is the fascia, almost smooth externally. The eyes, head, legs, and body generally are clothed with long but fine hairs.

One example of this insect received long ago from Dr. Baden is in my collection, but had, unfortunately, no precise locality. It is the larger specimen.

GYPONYX BRAUNSI, sp. n.

Elongatus, nigro-piceus; ore, antennis palpisque, thoracis margine antico, corpore subtus, pedibus (geniculis tibiisque exceptis) dilutioribus, rufo-piceis. Elytris basi indeterminate, fascia mediana (in marginem latissima postice bidentata) maculaque apicali obliqua testaceis. Thorace elongato, antice tenuiter, ad basin fortius constricto; elytris ad basin punctato-lineatis, seriebus vix ad medium vectis, externe deficientibus. Long. 13 *millim.*

Hab. Willowmore, Cape Colony (*Brauns*).

This species differs from any other known to me by its elongate thorax and its comparatively smooth and shining appearance, and also by the clear and distinct coloration and pattern of the elytra. The colour of the body, with the exception of the head and thorax, of the tips of the femora, and bases of the tibiæ, is a bright rusty red. The elytra have an oblique broad fascia, much indented, running backwards from below the callus to the suture, of a pitchy colour; a much broader patch before the apex of a lighter pitchy brown, deeply indented twice on its upper edge, and once on its lower edge, so that it is narrowest in the middle. The lines of punctures scarcely pass the first brown fascia, only four or five punctures being on the yellow median wide patch. The thorax is nearly twice as long as wide, its front margin is rufous, the sides very little widened, not deeply constricted in front, the base coarctate and margined, the punctuation close and fine, the disk a little flat. I have at present only seen the example described, which I have pleasure in naming after its captor, Dr. H. Brauns.

GRAPTOCLERUS Gorh.

Graptoclerus Gorh. Ann. & Mag. N. Hist. ser. 7, vii. p. 351 (1901); Schenk. *l. c.* p. 48, nota.

GRAPTOCLERUS QUADRIPUNCTATUS Gorh. *l. c.* p. 353.

Hab. Grahamstown, Cape Colony (Dunkerbosh, *Dr. Penther*). Described by me from Natal. 1 example.

TARSOSTENUS Spinola.

TARSOSTENUS UNIVITTATUS Rossi.

Hab. Willowmore (*Brauns*).

DOZOCOLLETUS Chevr.

Dozocolletus Schenk. *l. c.* p. 38.
Pezoporus Klug, Clerii, p. 311.

DOZOCOLLETUS BRUNNEUS Hintz, Deuts. ent. Zeit. 1902, p. 397?

Hab. Willowmore, Algoa Bay (*Brauns*). Bothaville, Orange R. Colony.

I have not seen Hintz's description, but I have little doubt that the insect taken in some numbers by Dr. Brauns is to be referred to it. This species has a large head, the thorax as wide in front as the head, the head and thorax deep pitchy brown, the elytra, legs, and body light brown, the punctuation and striæ are obsolete.

DOZOCOLLETUS SORDIDUS, sp. n.

Saturate brunneus; antennis palpisque rufo-brunneis, illis quam caput et thorax brevioribus, articulis quarto ad octavum quadratis, tribus ultimis transversis, apice compresso; capite prothoraceque creberrime confluenter, elytris fortiter striato-punctatis, femoribus clavatis. Long. 5 *millim.*

Hab. Algoa Bay (*Brauns*).

Smaller than the species which I have assumed to be *D. brunneus* Hintz, and especially to be distinguished from it by the shorter antennæ, which have much shorter joints; the second and third joints are a little longer than wide; the fourth to the eighth are about as long as wide, while the last three joints form a compact club and are transverse. The eyes are more prominent than in *D. brunneus*, the femora are strongly clavate. The thorax is as wide as the head in front, much narrowed to its base, obconic; the elytra small in proportion, elongate-ovate.

THRIOCERA Gorham.

Thriocera Gorham, Trans. Ent. Soc. Lond. 1878, p. 156; Schenk. *l. c.* p. 117.

THRIOCERA PECTORALIS Klug, Clerii, p. 348.

α. *Elytris unicoloribus fascia mediana plicata.*
Hab. Algoa Bay, Port Elizabeth (*Brauns*).

β. *Elytris basi rufis.*
Hab. Algoa Bay, Port Elizabeth (*Brauns*).

THRIOCERA BICINCTELLA, sp. n.

Nigra, nitida, tenuiter pubescens; antennis, palpis pedibusque rufo-brunneis, illis basi dilutioribus; prothorace brevi, antice tenuiter constricto, postice coarctato, lateribus rotundatis, disco inæquali impresso; elytris sublævibus, fasciis duabus elevatis, eburatis, ad suturam interruptis, anteriore (juxta callum) intus abbreviatis. Long. 5 *millim.*

Hab. Algoa Bay (*Brauns*).

Var., *capite, antennis, palpis, elytris usque ad fasciam posteriorem, corpore subtus cum pedibus rufo-ferrugineis.*

Hab. Port Elizabeth, Cape Colony (*Brauns*).

Antennæ as in *T. pectoralis*, but less robust, the two basal joints stout, the intermediate joints longer than wide, the three apical forming a lax club. The thorax is notably shorter than in *T. pectoralis* and of a different form, being much more narrowed towards the base; its disk is also roughly punctured and uneven, finely pubescent with long hairs, but neither it nor the elytra are so thickly pubescent as in *T. pectoralis*. The elytra are black, or, as in the variety, red to the second fascia. The fasciæ are raised and ivory-white, not clothed with silky-white hairs (as they are in *T. pectoralis*), but clear shining white; the anterior one is shortened, so as to leave a space at the suture equal to its own length, nor does it reach the margin.

There are two examples of the type form and two of the variety.

NOTOSTENUS Spinola.

Notostenus Schenk. *l. c.* p. 114.

NOTOSTENUS VIRIDIS Thun. Nov. Ins. vol. i. p. 9 (1784).

Hab. Algoa Bay (*Brauns*).

MELYRIDÆ.

ANTHOCOMUS Erichs.

ANTHOCOMUS CORIACEUS, sp. n.

Breviter oblongus, niger, obscure subviridescens, longe pubescens; capite prothoraceque nitidis, hoc profunde parce punctatus; elytris coriaceis; antennis (apice exceptis), tibiis tarsisque ferrugineis. Long. 4 *millim.*

Hab. Bothaville, Orange R. Colony (*Brauns*).

Black, densely clothed with long black pubescence. Head and thorax shining, the former very closely and finely, the latter very sparsely punctured. Clothed all over with long fine hairs. The mouth, palpi, antennæ (excepting the extreme tip), the tibiæ, and tarsi are ferruginous red. The elytra are little shining, coriaceous, tubercles obscurely in rows and but little elevated, being rather uniform all over their surface. There is a slight greenish, but hardly perceptible, tint over the whole upper surface; the body beneath is quite black. As there are only two specimens, and I cannot distinguish the sexes, it is impossible to say if this is a true *Anthocomus*. The lamellæ of the tarsi are about as long as the claws.

HEDYBIUS Erichson.

HEDYBIUS SCULPTICEPS, sp. n.

Nigro-subcæruleus; capite (basi excepta), antennis (articulis extus et apicem versus nigro notatis), prothoracis margine, pedibus

anticis et intermediis (externe nigris) testaceis; elytris cœruleis, purpureo vel violaceo micantibus. Long. 5·5–6·5 *millim.* ♂ ♀.

Mas, *capitis basi profunde excavato-eroso, erosione ima tota nigra; fronte elevata, in medio profunde sulcata. Antennis acute serratis, articulo quinto triangulari apice nigro.*

Femina, *antennis brevioribus, leviter serratis.*

Hab. Willowmore, Cape Colony (*Brauns*).

The head in the male is deeply excavated; the surrounding parts are yellow and elevated, but very differently from either of the *Hedybii* described by me in the 'Annals and Mag.' for Jan. 1900 *. The deep notch in the front part of this elevated edge of the crater is of itself sufficient to prevent its being confused with them. The base of the crater in the male and the base of the head in the female are black. The antennæ are more acutely serrate than in any other species I have seen. They vary in the degree to which they are marked with black. Their second joint is very short, the third as long as the basal, the fourth and fifth triangular, the last in the male always black in its apical half and more acutely produced inwards; the following joints are longer, acutely serrate, and more or less dark, in the females I have seen always dark.

The thorax is of the same shape as in *H. amœnus*, *H. anceps*, &c., but the disk is nearly all suffused with blue-black, two dark points project on the base, and it is sometimes indented on each side in front.

The scutellum is black; the elytra are blue and often have a beautiful metallic-violet reflection, they are finely coriaceous. The legs are yellow but tinged with black, and the hind pair are altogether dark, in which respect this insect also differs from any of the *Hedybii* of this group described.

Three males and two females of this species were sent me by Dr. H. Brauns.

HEDYBIUS QUADRICORNIS, sp. n.

Oblongus, nigro-cœruleus; capite, prothorace pedibusque sanguineis; scutello et elytris viridibus, sericeo-pubescentibus; antennis rufis, articulis singulis (maris) nigro-notatis, feminæ articulis basi tribus rufis usque ad apicem infuscatis. Long. 4–4·5 *millim.* ♂ ♀.

Mas, *capite excavato-eroso, erosionis margine basali in cornu duplici quasi elevato, cornu anteriore apice ciliato, posteriore hamato apice nigro, supra oculos tuberculato.*

Femina, *fronte deplanata, basin versus nigrescente.*

Hab. Willowmore, Cape Colony (*Brauns*).

Head, thorax, base of the antennæ, margins and apex of the abdomen yellow; the scutellum and elytra are bluish green. The upper side is finely clothed with a pruinose silky pubescence, long hairs are absent.

The head in the female and the front of the thorax in the male

* Ann. & Mag. N. H. ser. 7, v. p. 81 (1900).

are sometimes faintly suffused, and the hind tarsi are blackish. The body beneath is bluish. The extraordinary structure of the head in the male is alone sufficient to distinguish this insect from any species described; it resembles in colour and size an insect sent by Mr. G. A. K. Marshall from Salisbury, and which I doubtfully referred to *H. variicornis* Bohem., but as the latter specimen was a male I am certain that it does not belong to the species I now describe.

Obs.—Boheman does not in describing *H. superciliosus* give the diagnosis of the male head, but I have no doubt from his remarks it is a male he describes. His express assertion, repeated, that the scutellum is yellow precludes any of the specimens I have yet received from being referred to this species. A considerable series of this insect has been obtained by Dr. Brauns; four males and four females are before me.

HEDYBIUS AMŒNUS Gorh. Distant's Nat. in Transvaal, p. 197; Ann. & Mag. N. H. ser. 7, v. p. 80 (1900).

Hab. Bothaville, Orange R. Colony (*Brauns*).

One male and three females, in all respects agreeing with the types. They are interesting as corroborating the differences pointed out before and as being found in quite a new locality.

PHILHEDONUS Gorham.

Philhedonus Gorham, Ann. & Mag. N. H. ser. 7, v. p. 82 (1900).

PHILHEDONUS SERICEUS, sp. n.

Nigro-cæruleus, pube brevi sericea vestitus; prothorace rufo, fere glabro, macula nigra in margine antico haud bene discreta; elytris creberrime subtiliter punctatis, pube brevi pruinosis; scutello, pedibus et corpore infra nigro-cæruleis. Long. 5 millim. ♀ ?

Hab. Bothaville, Orange R. Colony (*Brauns*).

This *Philhedonus* differs from the insect described by me as *P. coronatus* by its smaller size, by the wholly black antennæ, and by the labrum not being red; the thorax is also differently marked, the single black spot is placed upon the front margin, and is wedge-shaped, pointing backwards. The head is blue-black and shining, not punctured, very sparingly golden pubescent; antennæ, mouth, and palpi black, the former short and feebly serrate. The thorax is wider than long, the sides and base finely margined, the anterior margin raised, but only very finely so.

The elytra are wide, and are widest a little before the apex, deep blue with a silky and shining pubescence; the punctuation is fine, close, and confluent. They do not cover the apex of the abdomen. The body and legs are entirely blue-black; the vesicles, which can be protruded from the sides (and are so in the specimens sent), are blood-red. The pygidial segments beyond the elytra show a green tinge. The examples, two in number, are both, I think, females.

PHILHEDONUS RUGULOSUS, sp. n.

Niger, nitidus, pube erecta nigra vestitus; prothorace rufo, plaga magna discoidali marginem basalem haud attingente nigra, parcius irregulariter punctato; elytris saturate cæruleis, ruguloso-coriaceis; scutello nigro; corpore infra cum pedibus nigris; antennis nigris, acute serratis. Long. 5·5 *millim.* ♀.

Mas, *antennis longioribus, acute serratis, capite intra oculos inæqualiter impresso.*

Femina, *antennis brevioribus, minus acute serratis, fronte plana.*

Hab. Willowmore, Cape Colony (*Brauns*).

Rather like *P. sericeus.* Head, mouth, antennæ, palpi, legs, and body beneath black. The head is uneven and impressed between the eyes, the base is nearly smooth and shining; the antennæ have the first three joints testaceous beneath, from the fourth to the tenth the joints are longer than wide, acutely produced at their inner apices. The thorax has a large black and square patch on the disk and front margin; this is somewhat produced behind, but does not reach the hind margin; the disk is smooth in front, but punctured and rugose at the sides. The form is like that of *P. sericeus*, transverse, rounded at the sides and base, without angles; finely margined, and a little elevated in front. The disk and the elytra are clothed with long upright black hairs. The elytra are of a deep violaceous or indigo-blue, uniformly rugulose; the rugosities are tuberculous. They are widest a little before their apices, the apex broadly rounded. In addition to the black erect hairs there is a white, shining, pruinose pubescence, arranged in fasciæ (but not very evidently so).

The legs and underside are wholly jet-black.

The male has the head unevenly impressed between the eyes, the antennæ more acutely serrate, and of course the front tarsi four-jointed. The elytra cover the abdomen in all of the four specimens before me; in the female the segments of the abdomen when distended appear narrowly margined with red.

HEDONISTES, gen. nov.

Labrum corneum.

Tarsi antici quinque-articulati; caput maris eroso-excisum, feminæ fronte plana; antennæ maris articulo basali quinto et sexto ampliatis, septimo ad undecimum simplicibus; feminæ articulis omnibus simplicibus.

Hab. Africam meridionalem.

A genus recalling by the curious sexual characters of the antennæ in the male the genera *Laius* from Australia and *Collops* from the New World, and by its excavated and cornuted head in the male the genus *Hedybius*, with which it might have been associated; but I think although the enlarged fifth and sixth joints of the antennæ are only a sexual character, it is one so similar to what is found in *Laius* and *Collops* that it will be well to keep insects of this family possessing it in a separate

genus. M. Fairmaire has described some species as to be attributed to *Laius*, from Madagascar, Nossi Bé. I have not seen them, but I suspect it will be found that there are such radical differences as to preclude such an association; and he does not mention enlarged joints. *Laius*, it may be observed, was founded upon a female example from Australia, and ought strictly to be suppressed for Westwood's name *Megadeuterus*, which at least expresses the fact that the second joint of the antennæ is enlarged in the male sex. That he included other insects in his genus is no reason for suppressing the name, but only for confining it to the type, and to such as can be associated with it.

HEDONISTES LÆTUS, sp. n.

Brevis, niger, pube brevi cinerea erecta vestitus, valde punctatus; elytris subquadratis, grosse et confluenter punctatis, fascia lata, ad marginem latissima, apiceque læte sanguineis; epistomate, labro ad apicem et antennarum basi rufis. Long. 4·5-5 *millim.* ♂ ♀.

MAS, *capite eroso-excavato, ad antennarum basin utrinque carinato elevato, basi triangulariter elevato, elevatione in medio sulcata, antice ciliata, bicirrosa; antennarum articulis basali quinto et sexto ampliatis.*

Femina, *fronte plana, antennis simplicibus.*

Hab. Willowmore, Cape Colony (*Brauns*).

Head and thorax black, thickly and the latter rather coarsely punctured; the antennæ have four joints at the base red, the rest black, the apical joint is elongate, the intermediate joints in the male are longer than wide, in the female about as long as wide, not serrate but rather triangular. The thorax is shining, not wider than the head, and much narrower than the elytra at the base, somewhat cordate, with the margins a little reflexed. The elytra are blue-black, with a fascia which is interrupted at the suture, but very broad on the margin, of a fine blood-red, and their apex is rather broadly margined with the same colour; the basal side of the fascia is produced along the margin so as to surround the shoulder; their surface is uniformly, coarsely, and in places confluently punctured, honeycombed. The legs are black.

Eight examples, consisting equally of each sex, were sent me by Dr. H. Brauns, by whom they were obtained at Willowmore in Cape Colony.

EROTYLIDÆ.

AMBLYSCELIS HÆMORRHOUS Gorh. Ann. Soc. Ent. Belg. 1885, p. 326; Ann. & Mag. N. H. ser. 7, v. p. 90 (1900).

Hab. Bothaville, Orange R. Colony.

Excepting that the brownish-yellow colour is more diffused in two examples from Bothaville, so that one is wholly brown with darker striæ, and the other has a not very well-defined yellow vitta, formed by the humeral spot extending to meet the apical

yellow, there is no difference in these examples and those from Natal.

ENDOMYCHIDÆ.

ŒDIARTHRUS Gerst.

Œdiarthrus Gerst. Mon. Endom. p. 344.

ŒDIARTHRUS ALGOENSIS, sp. n.

Œ. natalensi *similis et affinis. Ferrugineus, antennis, palpis pedibusque nigris, tibiis rectis. Long.* 4·5 *millim.* ♂.

Mas, *antennarum articulo nono ampliato.*

Hab. Algoa Bay (*Brauns*). 1 example.

Rather larger than *Œ. natalensis*, and differing from it in having the antennæ wholly black, with all the joints rather longer and more stoutly built; the ninth joint is triangularly enlarged, as in other species of this genus, in the males; the two terminal joints are formed quite as in *Œ. natalensis*, but are larger.

The legs are black and have their tibiæ straight, which alone is sufficient to distinguish this species from *Œ. natalensis*. For some general remarks on the genus I must refer to Ann. & Mag. N. H. ser. 7, vii. p. 402 (1901).

LYCOPERDINA SERICEA Gerst. Mon. Endom. p. 218?

Hab. Algoa Bay, Cape Colony (*Brauns*).

There is a single specimen of a very small *Lycoperdina* in Dr. Brauns' collection which I refer to this species with some little doubt.

8. On the Fœtus and Placenta of the Spiny Mouse (*Acomys cahirinus*). By RICHARD ASSHETON, M.A., F.Z.S., Lecturer in Biology in the Medical School of Guy's Hospital, University of London.

[Received May 23, 1905.]

(Text-figures 41–45.)

I received from Mr. F. E. Beddard, F.R.S., Prosecton to the Zoological Gardens, London, a bottle containing the fœtus and uterus from an individual of the Spiny Mouse (*Acomys cahirinus*). The exact age of the fœtus was not known, but the figure (text-fig. 41) given here shows that it was well advanced.

In the bottle were three objects—namely, the fœtus and placenta (as shown in text-fig. 41), the uterus with Fallopian tubes and ovaries, and a third object which was a partially absorbed fœtus and placenta.

The uterus is bicornuate; each horn measures about 18–20 mm., and passes gradually into the Fallopian tube, a short, coiled tube lying alongside the ovary (4 mm. × 2 mm.).

Each horn had been opened. Opposite the slit on the mesometric side a swelling marked the place of attachment of the fully formed placenta and fœtus in the one case, and of the absorbed specimen in the other.

The fœtus appeared devoid of amnion and was chiefly remarkable for the long hairs or spines which rise from the dorsal walls of the nostrils and point backwards over the head. The pits from which these hairs arise are plainly visible (text-fig. 41).

Text-fig. 41.

The fœtus of *Acomys cahirinus*, together with the placenta separated from the walls of the uterus. The sac-like folds attached to the discoid placenta are the yolk-sac and amnion membranes. An epitrichium is seen closely applied to the body of the fœtus. × 3.

A thin membrane could be seen covering certain parts of the embryo, the face, neck, and wrist, and it could be detected by careful search over other parts. This membrane covered the finer hairs, but was perforated by the stout bristles, and is probably of the nature of an epitrichium.

The fœtus was attached by a long cord to the placenta, which had been separated from the uterus.

The placenta was discoidal in shape, but with a longer diameter of 12 mm. and a shorter of 9·5 mm. In thickness it was about 3 mm. The embryonic surface was concave, the ab-embryonic surface convex (text-fig. 42).

Attached to the proximal (fœtal) surface of the placenta was a wide sac through which the cord passed to the centre of the placenta.

At the point where the cord appears to penetrate the sac there

was a crumpled mass of membranes, consisting of the yolk-sac and amnion, which had been detached from the fœtus during the act of preservation.

Description of the Placenta.

The proximal wall of the yolk-sac, which lies up against the face of the placenta, is extremely vascular and covered with an epithelium of large columnar cells. Moreover, this epithelium is much folded; and the blood-vessels lie in the folds, and so approach closely the surface of the placenta (text-fig. 42). The yolk-sac wall is firmly attached to the placenta over the peripheral area.

Text-fig. 42.

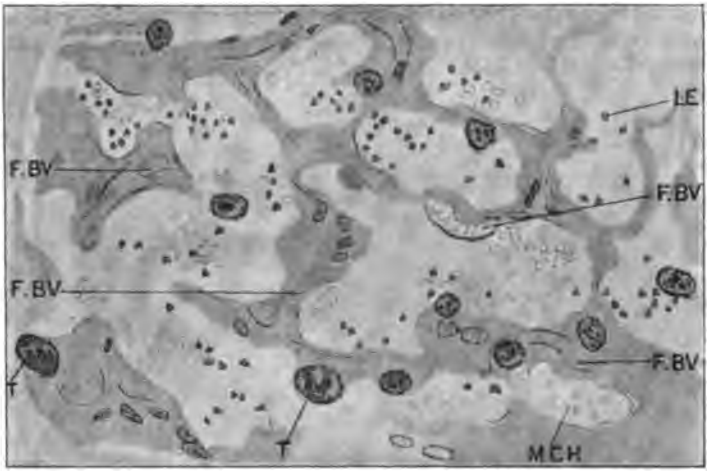
The placenta of *Acomys* with the proximal wall of the yolk-sac attached showing the radiating vessels of yolk-sac circulation which are covered with a thick epithelium. × 3.

This attachment of the yolk-sac to the placenta is not so intimate as it is in the common rat, in which animal the yolk-sac forms villi or at least folds which become embedded in the tissues of the allantoic placenta, but remain quite easily distinguishable therefrom (*cf.* Robinson, A., "The Nutritive Importance of the Yolk-sac," Journ. Anat. & Phys. vol. xxvi. p. 308 (1892); Duval, M., "Le placenta des Rongeurs," Journ. Anat. et Phys. 1889–1892). In *Acomys* the yolk-sac is much folded, but the folds do not become involved in the placental tissues (text-fig. 45, HH).

The placenta itself, which we may regard as being nearly full term, shows only a small area of actual vascular attachment to the wall of the uterus (text-figs. 41, 42). Here it is rough, and marked by open blood-sinuses and shreds of tissue. Passing outwards and extending nearly to the rim, there is a layer of rather darkly staining material showing no particular structure

and containing dead nuclei, which I must regard as cell-detritus. This layer probably lay against, and was no doubt more or less attached to, the uterine wall (text-fig. 45, D).

Text-fig. 43.



A section of a portion of the placenta of *Acomys* taken vertically near the centre of the organ, where the fœtal capillaries are forming a network round about the channels containing maternal blood.

F.BV. Fœtal capillary. LE. Maternal leucocyte. MCH. Maternal blood in channels excavated in the trophoblast of the fœtus. T. Trophoblast nuclei. × 480.

From this point and passing over the edge of the placenta, and covering the free surface of the fœtal side of the placenta, a flattened attenuated epithelium can be distinguished (text-fig. 45, H, p. 285). This becomes thicker and more cubical as it nears the point at which the yolk-sac wall is connected with the placenta, and here it passes into the decidedly cubical or columnar epithelium of the yolk-sac. This layer continued in the other direction would pass at some period into the distal wall of the yolk-sac, though whether this distal wall exists at the period under examination I cannot say.

The rough surface of vascular attachment, so far as I can judge from the general character of the cells, is composed entirely of maternal tissue. This tissue is of that kind so frequently found where trophoblastic ingrowth is about to take place, and had been named by Hubrecht trophospongia (text-fig. 44, p. 284).

Text-fig. 45 is a diagrammatic representation of a section passing through the centre of the placenta. The placenta, as

stated above, had been separated from the wall of the uterus, so although shown *in situ* in the figure it must be understood that the two parts were not together in my specimen. The line S marks the boundary between the two.

On the outside I have drawn in outline the muscle coats (M) of the wall of the uterus.

Within this, and seen only near the centre, is the trophospongial tissue alluded to above (TS), while towards the peripheral parts the thin layer of detritus can be seen at D, composed probably of both maternal and fœtal tissues.

Text-fig. 44.

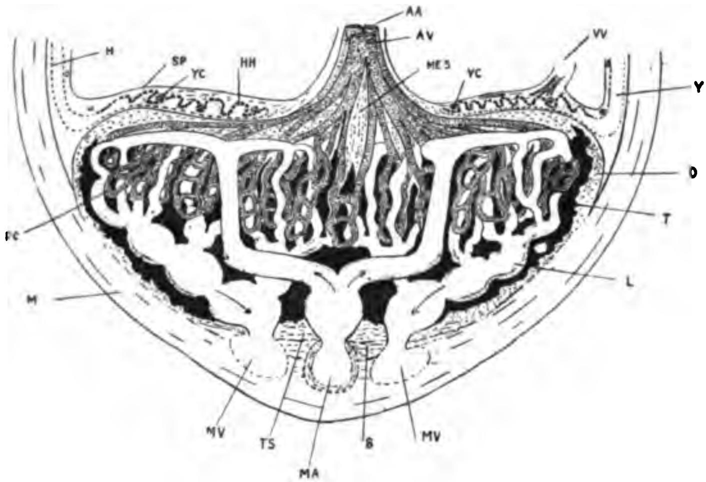
A section through the junction between trophoblast and trophospongia of *Acomys*.

T. Trophoblast. TS. Trophospongia. EP. Pseudoepithelium of trophoblast. EP'. Pseudoepithelium of trophospongia. MCH. Maternal blood.

Everything within this line formed by the detritus layer on the outside and the trophospongial layer at the centre is probably fœtal in origin, except the maternal blood, which is extravasated and flowing in channels excavated in the fœtal trophoblast. It must of course be remembered that this description is an interpretation of a single stage based upon the known facts in closely allied forms (ref. Duval, Robinson, Jenkinson), and not upon the study of the actual development in this genus.

The advancing edge of the trophoblast is sharply defined from the maternal tissue (text-fig. 44, T). The trophoblast is composed of a compact mass of cells with large nuclei and generally fairly well-marked cell-boundaries. It has, in fact, the character more of a cytotrophoblast than a plasmodi-trophoblast (text-fig. 44). The nuclei tend to arrange themselves in pairs.

Text-fig. 45.



A diagram of a section taken through the centre of the placenta of *Acomys*. The maternal channels are not much exaggerated in size, but the fœtal capillaries are considerably magnified. The trophoblast layer in the region of the fœtal capillaries is not nearly so much attenuated as it should be.
The fœtal vessels are dotted, the channels containing maternal blood are white. The deep black is trophoblast.

AA. Allantoic artery. AV. Allantoic vein. D. Layer of cell-detritus probably fœtal as well as maternal. FC. Fœtal capillary. H. Hypoblast of the parietal wall of the yolk-sac. HH. Hypoblast of the proximal wall of the yolk-sac, very much folded. L. Lacunæ in trophoblast containing maternal blood. M. Muscle-coat of uterus. MA. Maternal artery. MES. Mesoblast of fœtus. MV. Maternal vein. S. Line along which the placenta had been detached from the uterus. SP. Splanchnopleur layer of mesoblast. T. Trophoblast. TS. Trophospongia. VV. Approximate portion of the main vitelline vessels. Y. Cavity of the yolk-sac. YC. Blood-vessels of the yolk-sac circulation.

This trophoblastic tissue, which in the figure (text-fig. 45) is shown as a thick black mass (T), is honeycombed by channels containing maternal blood (L), which channels become more broken and more numerous nearer to the fœtal surface, and the trophoblast consequently more attenuated. I think there are possibly other cavities in the trophoblast-cells which are not blood-spaces.

This mass of tissue formed entirely of trophoblast and maternal

blood makes up nearly half the thickness of the placenta, and contains no fœtal mesoblast or blood.

The half of the placenta towards the fœtal surface is made up of trophoblast (much attenuated) forming channels filled with maternal blood, which take a more or less sinuous course, and a network of fine fœtal capillaries, with also the larger vessels and larger main maternal channels. This is shown diagrammatically in text-fig. 45, FC, p. 285).

Text-fig. 43 (p. 283) is a drawing of an actual section of a piece of this region near the maternal surface. The great bulk is made up of the channels (MCH) excavated in the trophoblast containing maternal blood. There are many leucocytes (LE). The walls of these channels are thin, though the large trophoblastic nuclei (T) are very conspicuous. The fœtal capillaries are seen at F.BV.

Nearer to the fœtal surface the maternal channels become finer and the fœtal capillaries perhaps rather more numerous. At places where the main fœtal arteries penetrate the tissues of the placenta, a considerable quantity of fœtal mesoblast tissue accompanies them.

There are a few spherical masses of tissue within this region, which are not vascular, nor do they seem to be trophoblastic. They resemble in some respects Duval's "îlots vésiculeux," which, according to him, are pieces of the maternal sub-mucosa which have become enveloped by the advancing trophoblast layer.

The main features of the vascular systems are fairly easily determinable.

In this specimen the whole of the maternal arterial blood-supply arises from a single artery in the centre (MA), which opens into the large afferent channel which lies partly in the trophospongial tissue and partly in the trophoblast.

This, like the other main channels, is lined by a flattened epithelium-like layer, which is probably a pseudo-epithelium of trophoblastic origin where the wall is trophoblast, and tropho-spongial origin where the wall is trophospongia.

Duval has described the growth inwards along the maternal vessels of trophoblast cells to form a pseudo-epithelium. This is denied by Jenkinson*, who derives the pseudo-epithelium from the simple flattening of the adjacent cells. This is not a question which can be decided by reference to a single stage; but I may say that there is nothing in this specimen which supports in any way Duval's account in the mouse.

The afferent channel divides into two main branches, which diverge and then penetrate straight to the fœtal surface of the placenta. Here they break up into channels, which take a rather more sinuous course back again to the middle of the thickness of the placenta, where they collect into a number of efferent channels lying near the surface of the trophoblast and ultimately into two

* Jenkinson, J. W., "Observations on the Histology and Physiology of the Placenta of the Mouse," Tijdschr. d. Ned. Dierk. Vereen. Dl. vii. 1902.

large efferent vessels which presumably debouch into two maternal veins (MV).

These large efferent maternal vessels are more peripheral in position than the afferent courses.

The fœtal blood-supply is less easily followed. The allantoic arteries, on reaching the surface of the placenta, radiate and subdivide and give off branches which pass into the placenta at intervals over the more central part of the surface. These pass (as regards the main stream) straight through the fœtal half of the placenta, but give off at frequent intervals small capillaries, which take a more sinuous and radial course, anastomosing, forming network, and collecting together again into veins, which I believe to run parallel with the arteries of the villus.

A considerable amount of connective tissue accompanies these villi for the first part of their ingress into the placenta.

Comparison with other Placentas.

The placenta is clearly of the type which I have described elsewhere as cumulate as contrasted with the plicate type characteristic of such groups as the Ungulates.

The general shape, the arrangement of the membranes and their character, resemble, according to the interpretation placed upon them above, the condition that pertains in *Mus musculus*, and, rather less closely, that of *Mus decumanus*.

Jenkinson has recently given an account of the development of the placenta of the Mouse, which differs in several important particulars from that of Duval, which, until that time, had been generally accepted.

Jenkinson agrees with Duval as regards the general arrangement of membranes and in the main features of the development.

He differs, however, in respect to the vascular system, and my account given above is in complete agreement with Jenkinson. I see also nothing to suggest the appearance of an ingrowth of the trophoblast into the maternal blood-vessels, and growth along the inside as described by Duval ("plasmode endovasculaire").

Another point of disagreement is with reference to the glycogenous tissue. Duval takes but little notice of this and does not seem to have found the maternal glycogenous mass, which, according to Jenkinson, degenerates, and the space occupied by it becomes subsequently filled with a second glycogenous tissue which is of fœtal (trophoblastic) origin.

This is a matter of very considerable interest. It is not to be expected that an isolated case in an allied genus can afford any conclusive evidence.

Unfortunately the method of preservation (corrosive sublimate) is not suitable to the study of glycogen.

Tested with iodine I find no trace of glycogen, but there are certain spaces in the trophoblast cells alluded to in the foregoing

which may possibly have contained glycogen—so my evidence on this point is negative.

Along the line which marks the internal limit of the fœtal mesoblast (that is to say, the limit of the capillary system of the fœtal villi) a deposit of brown pigment occurs. This appears to be deposited in the walls of the capillaries, by the endothelium. It occurs nowhere else. Treated with the ferrocyanide test, it shows no trace of blue colour.

In the detritus in the layer D (text-fig. 45, p. 285) there are indications of the presence of free iron.

Summary.

To recapitulate my interpretation of the single specimen I possess. The placenta of *Acomys cahirinus* is a compound structure of maternal and fœtal tissues in which, excepting the blood, the fœtal tissue largely preponderates.

On the maternal side is a central area of attachment through which the maternal blood gains access to the placenta. Here a thin layer of maternal connective tissue surrounds the main afferent and efferent maternal blood-channels.

Within this region comes a thick layer of tissue probably of fœtal origin (the trophoblast, the cells of which are large, stain deeply, and have large nuclei), containing intercellular spaces, which are continuous with the expanded maternal vessels just named. These spaces are lined by an endothelium, as to the origin of which I can give no account. There is no fœtal blood in this part of the placenta.

These two regions, of which the latter is by far the larger, make up nearly one half of the whole placenta.

The rest (that is, all towards the fœtus) is composed of channels probably excavated in the trophoblast of the fœtus and containing maternal blood interlacing with much branched tufts of fœtal capillaries containing fœtal blood. These fœtal capillaries are in parts thickly covered with fœtal mesoblastic tissue, but more often are separated from the maternal blood by their own endothelium and a single layer of trophoblast only.

The maternal afferent channels penetrate to the fœtal surface before undergoing much subdivision and are more central in position.

The fœtal afferent vessels tend to penetrate the deeper layers, but begin to break up nearer to the surface of approach than is the case with the maternal afferent vessels.

There is no such intimate connection between the yolk-sac and allantoic placenta as there is in the Rat.

9. Remarks on the supposed Clavicle of the Sauropodous Dinosaur *Diplodocus*. By FRANCIS, BARON NOPCSA, Ph.D.*

[Received June 6, 1905.]

(Text-figures 46–49.)

It is still uncertain whether the extinct Dinosauria possessed clavicles.

Considering the close relationship existing between these reptiles, the Rhynchocephalians, Parasuchians, and Birds—this last relationship being shown by the continuous tendency of Dinosaurs to specialize on most different occasions in bird-like manner—one is at first naturally induced to believe that in Dinosaurs clavicles were present; but, as a matter of fact, bone after bone supposed to represent this element has had to be removed from this position.

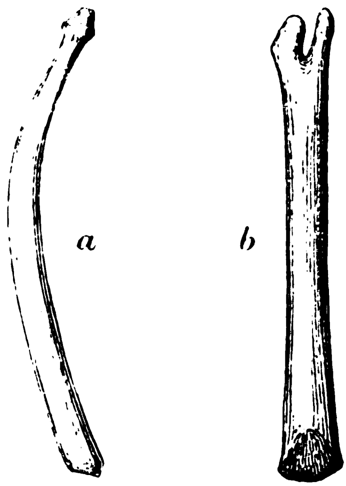
Hitherto only the family Ornithopodidæ is known to possess, in addition to scapula and coracoid, a curious further element in the shoulder-girdle, which was called clavicula, but may quite as well form only a part of the sternum (this double element being in one case united in the middle by bony matter). No other Saurischian or Orthopodous Dinosaur shows a clavicular ossification. It is true that in the Sauropoda, besides scapula and coracoid, one or two flat bones are always present in the scapular region of the body: these, however, do not represent claviculæ, but may with certainty be determined as ossifications of the sternum. The discovery, therefore, of what may be called a supernumerary bone besides the sternal plates in two of the several *Diplodocus* skeletons known to science proves to be of quite exceptional interest.

Hatcher, in his important Monographs of the *Diplodocus* skeletons Nos. 84 and 662 of the Carnegie Museum, describes this element as follows:—"Throughout the greater portion of its length it is circular in cross-section, it is bifid at one extremity and slightly expanded at the other. It is strongly curved, especially toward the bifid extremity. It is asymmetrical." In a more complete specimen (No. 662) than the former (84) it is "somewhat expanded and spatulate; the flattened extremity presents a slightly rugose surface, as though it had been imbedded in cartilaginous or muscular tissue, and this together with the bifid nature of the other extremity has suggested the possibility that the bone might be an os penis." After the description of this bone, however, its asymmetry is regarded by this eminent palæontologist as a weighty argument against its being an os penis, and therefore its identification with the clavicula is advocated.

* Communicated by Dr. A. SMITH WOODWARD, F.R.S., F.Z.S.

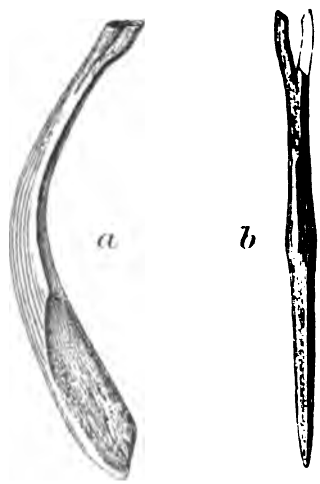
According to the figures given by Hatcher and reproduced here (text-figs. 46 & 47) the bone in question seems to present a great deal of what might be termed individual variation.

Text-fig. 46.



Supposed clavicula of *Diplodocus*, No. 84.

Text-fig. 47.



Same bone of *Diplodocus*, No. 662.

It seems to fit fairly well into the shoulder-girdle, but still

there are several points to be brought forward against the theory of its clavicular nature.

Firstly, it must be remembered that in one case this problematical bone, like the greater part of the skeleton, was displaced and that in the second skeleton, as pointed out by Dr. Holland, the femur bears tooth-marks of carnivorous Dinosaurs. In consequence of this the relative position of the bone cannot prove anything for or against its being an os penis; for the penis would be one of the first parts of the body to become displaced by decomposition and the first part that would be torn away if carnivorous animals were gnawing at the dead body.

Text-fig. 48.

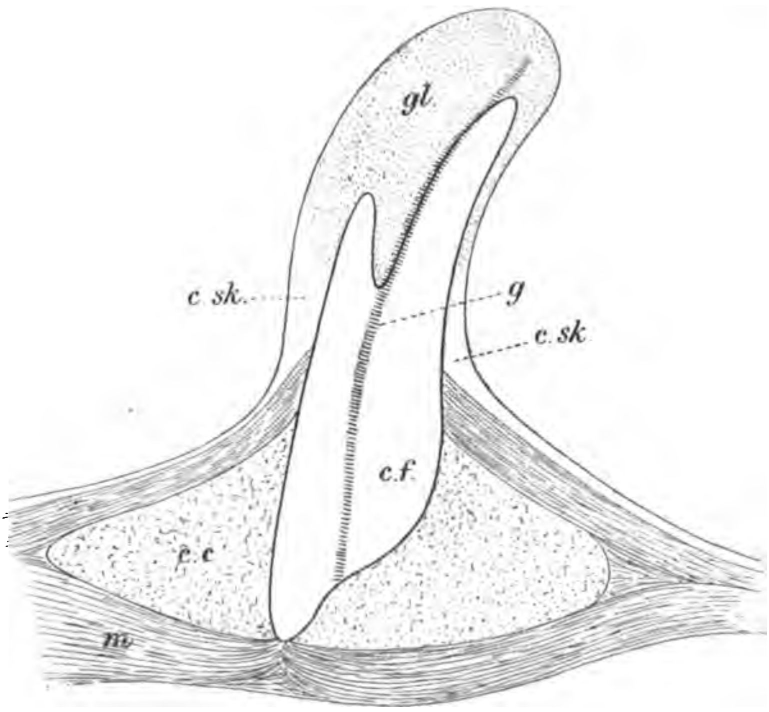


Diagram of penis of *Struthio*.

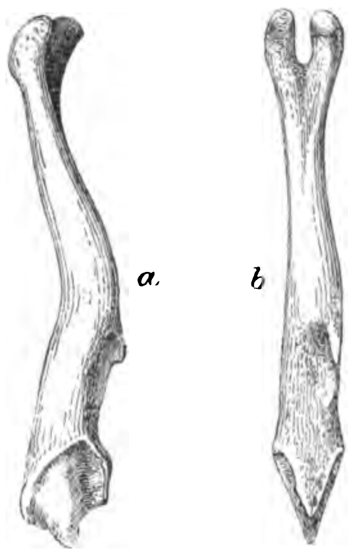
Explanation of letters:—*c.c.*, corpus cavernosum; *c.f.*, corpus fibrosum; *c.sk.*, coarse skin; *g.*, gutter; *gl.*, glans-like part; *m.*, muscles.

Secondly, in each of the two pretty complete skeletons that comprised this bone, only one example was present, and this one appeared to belong to the same side of the body. In other specimens of *Diplodocus* the element was altogether wanting.

This highly remarkable coincidence suggests the probability that the bone in question represents an asymmetrical but nevertheless unpaired organ.

So far as I am aware there is no known reptile, living or extinct, in which the clavicle is bifurcated at one end. Moreover, in most terrestrial and aquatic reptiles, when clavicles are present there is also an interclavicle, which has never been found in Sauropoda. It must also be remembered that these large herbivorous Dinosaurs were probably descended from the carnivorous Theropoda, which are always destitute of a clavicular arch.

Text-fig. 49.



Os penis of European Otter.

I am therefore of opinion that the problematical bone of *Diplodocus* in question cannot be a clavicle, and it is necessary to consider Hatcher's alternative suggestion that it is an os penis.

The fact that existing birds and reptiles are destitute of an os penis does not necessarily imply that gigantic reptiles like *Diplodocus* similarly lacked the bone. Among Mammalia it is well known that the element occurs only sporadically, being present, for instance, in the Anthropoid Apes and absent in Man.

Among the living reptiles we know two types of genital organs. The Squamata show what may be called a bifid penis, while the Crocodilia and Chelonia have the penis simple exteriorly, with a corpus fibrosum and frequently even a glans penis well developed.

In Chelonia the penis sometimes exhibits internally a partially bifid structure.

For the purpose of this paper the penis of birds is of quite exceptional interest. In its origin it is not only traceable to the Crocodilian type, but shows a very great amount of asymmetry, and besides in the Ratitæ a distal bifurcation of the corpus fibrosum (text-fig. 48, p. 291). In *Struthio* the distal part of the penis is changed into a glans-like organ, while in *Rhea* the corpus fibrosum consists of an exceedingly hard and nearly cartilaginous substance.

A bifurcation like that observable in the problematical bone of *Diplodocus* is also frequently to be met with at the distal end of the mammalian os penis, which is often asymmetrical. The os penis of mammals always shows quite remarkable variability. For comparison with the bone of *Diplodocus*, side and hind views of the os penis of the European Otter (*Lutra lutra*) are given (in text-fig. 49, p. 292), and one can see at a glance the well-rounded, smooth, condyle-like, distal ends, the proximal rugosities, and the lateral impressions for the attachment of the corpus fibrosum. In other mammals the corpus fibrosum is not attached laterally to the ossified element, but ends in a deep pit situated at the proximal end of the latter.

We have therefore to consider the following propositions :—

(1) That among the Mammalia it is the corpus fibrosum with which the os penis comes in close contact, forming the anterior prolongation into the glans penis, that the os penis ossifies from fibrous matter; that a corpus fibrosum is also present among Reptilia, and that therefore an os penis in Dinosaurs can only have originated from the corpus fibrosum.

(2) That in *Rhea* the corpus fibrosum is quite as hard as cartilage, and differs from this only by not possessing cartilage-cells.

(3) That in Sauropsida a glans is frequently present.

(4) That it is quite a common thing to find bird-like characters in various parts of the Dinosaurian skeleton.

(5) That among the birds the Ratites show the most primitive and still the best-developed male genital organ.

(6) That the shape and variation of the problematical bone in *Diplodocus* are well in accord with its being an os penis, while they militate against its determination as clavicular.

(7) Lastly, that this so-called clavicula when present is always found only as an unpaired organ showing the same direction of curvature.

Hence I am of opinion that it is at present advisable to remove the subject of this paper from the shoulder-girdle and determine it as the ossified axis of the penis.

Further evidence and, especially, further discoveries are naturally necessary before so delicate a question can be regarded as definitely settled; but since Hatcher's single argument against the bone in question being an os penis (namely, its asymmetry) breaks down on reference to *Struthio* or even to *Lutra*, the balance of the argument is at present in favour of this newer interpretation.

The existence of clavicles in Dinosauria must therefore still be considered doubtful.

In conclusion, I wish to express my thanks to Mr. Boulenger, Dr. Forsyth Major, Mr. Pycraft, and Dr. A. S. Woodward at the British Museum, and to Professor Stewart and Mr. R. H. Burne at the Royal College of Surgeons, for their kind help in studying so intricate a question.

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——. "Osteology of *Haplocanthosaurus*, with Appendix on *Diplodocus.*" *Loc. cit.* vol. ii.

[NOPCSA.]—Critical Review of Hatcher's Paper on *Haplocanthosaurus.* Keilhack's Geologisches Centralblatt, 1904.

WEBER.—Die Säugethiere. Leipzig, 1903.

WIEDERSHEIM.—Lehrbuch der vergleichenden Anatomie d. Wirbelthiere. Leipzig, 1902.

No. 19.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

May 2nd, 1905.

Dr. W. T. BLANFORD, C.I.E., F.R.S., Vice-President, in the Chair.

The SECRETARY exhibited three large photographs, presented to the Society by Mr. Howard B. Turner, of Hippopotamuses swimming in a river in their native haunts.

Mr. R. E. HOLDING exhibited and made remarks on a series of antlers, of the first year, of the Roebuck, Red-Deer, Fallow-Deer, and Wapiti.

Mr. R. I. POCOCK, F.Z.S., exhibited and made remarks on a specimen of the Spanish Tarantula, *Lycosa hispanica*, that had died in the Society's Gardens.

Mr. W. BATESON, F.R.S., exhibited a series of specimens of domestic chicks to illustrate peculiarities in the hereditary transmission of white plumage.

Mr. GEORGE R. ALFORD communicated a paper by Prof. E. A. MINCHIN entitled "On *Leucosolenia contorta* (Bowerbank), *Ascandra contorta* Haeckel, and *Ascetta spinosa* Lendenfeld." The author pointed out that the nomenclature of the Calcarea Homocœla was in a more tangled state than that of any other group of the animal kingdom, with, perhaps, the exception of the malarial parasites. Dr. Bowerbank, who founded the species,

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* This Abstract is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of Meeting to which it refers. It will be issued, free of extra charge, to all Fellows who subscribe to the Publications, along with the 'Proceedings'; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

gave a diagnosis that would fit any Ascon, and his type specimens were jumbles of three or four species; consequently Prof. Minchin declared his name to be of no systematic value whatever. To Haeckel's name *Ascandra contorta*, Prof. Minchin referred a sponge extremely abundant on the Mediterranean coasts of France. Haeckel also pointed out that Dr. Bowerbank's diagnosis was not definitive of the species, and diagnosed the species by details of spiculation. In this he was incorrect in saying the monaxons were possessed of lance-head distal ends, and that gastral rays of the quadriradiates "curved."

Prof. Minchin preferred to name *Ascandra contorta* H. as *Clathrina contorta*, having a closely reticulate mode of growth, equiangular triradiate systems, collar-cells with basal nucleus, and parenchymula larva.

He showed that the monaxon spicules were very variable—so much so, as to explain the name *Ascetta spinosa* Len. All specimens of *spinosa* examined by him were of small size, not like the broad spreading growth of *contorta* containing monaxon spicules; and having examined a slide labelled *Ascetta spinosa* in Lendenfeld's handwriting, and having found the triradiate systems exactly similar to those of the true *contorta*, he came to the conclusion that the *Ascetta spinosa* was only an age variation of *Clathrina contorta*, not yet possessing monaxon spicules.

He discussed the question whether there was justification for a new species or whether this should be regarded as a variation only, on the grounds of the formation of spicules, and which were primary monaxons and which were secondary.

Mr. F. E. Beddard, F.R.S., read some notes on the Anatomy of the Ferret-Badger (*Helictis personata*), based on a dissection of a specimen that had recently died in the Society's Gardens.

Mr. W. P. Pycraft, F.Z.S., read a paper on the Osteology of the *Eurylæmidæ*, and briefly discussed the question of the systematic position of this group.

While agreeing with the general concensus of opinion as to the primitive character of these birds, he held that the isolated position which they were supposed to occupy with regard to the remaining Passeres was by no means justified by facts.

The pterylography, osteology, and myology of the *Eurylæmidæ* all tended to show that the nearest allies of these birds were the *Cotingidæ*.

Although undoubtedly primitive, the group, Mr. Pycraft pointed out, presented a number of specialised characters, which were especially marked in the skull and muscles of the wing.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 16th May, 1905, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. F. E. BEDDARD, F.R.S.—A Contribution to the Knowledge of the Encephalic Arterial System in Sauropsida.

2. Dr. E. BERGROTH, C.M.Z.S.—On Stridulating *Halyinæ*, with Descriptions of new Genera and Species.

3. Sir HARRY JOHNSTON, G.C.M.G., K.C.B.—On the Classification of the Anthropoid Apes as proposed by the Hon. Walter Rothschild.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 HANOVER SQUARE, LONDON, W.
9th May, 1905.

No. 20.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

May 16th, 1905.

G. A. Boulenger, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of April 1905, and called special attention to a young female Chimpanzee (*Anthropopithecus troglodytes*), deposited; to a young female Giraffe from Northern Nigeria, probably belonging to the race known as *Giraffa camelopardalis peralta*, purchased; to a young male Huanaco (*Lama huanacos*) from Punta Arenas, Tierra del Fuego, presented by Mr. Moritz Braun and Capt. R. Crawshay; and to a pair of Concave-casqued Hornbills (*Dichoceros bicornis*) from India, purchased.

Mr. Oldfield Thomas, F.R.S., exhibited examples of a new Golden Mole which had been obtained in connection with Mr. C. D. Rudd's exploration of South Africa, and which he proposed to call

Amblysomus corriæ, sp. n.

Smoky blackish above and below, darker than in *A. iris*. Skull less broadened behind than in *A. hottentottus*.

Head and body 129 mm.; hind foot 13; greatest skull length 28.

Hab. Knysna, Cape Colony.

Type. Male. B.M. No. 5.5.5.5. No. 1021 of the Rudd collection.

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Mr. H. B. FANTHAM, B.Sc., F.Z.S., exhibited and made remarks upon microscopic slides of *Lankesterella tritonis*, a Hæmogregarine parasitic in the blood-corpuscles of a Newt, *Triton cristatus*. This parasite was recently found by Mr. A. S. Hirst, F.Z.S., and the exhibitor, and their observations had since been independently confirmed by Dr. A. C. Stevenson.

Mr. F. E. BEDDARD, F.R.S., read a paper entitled "A Contribution to the Knowledge of the Encephalic Arterial System in Sauropsida."

Sir HARRY JOHNSTON, G.C.M.G., K.C.B., read a paper containing criticisms of the Hon. Walter Rothschild's proposed classification of the Anthropoid Apes. He was disposed to agree with Mr. Rothschild's classification of the African Apes, but suggested that the proper transcription of the native name for the Bald Chimpanzee should be *nkulunkamba* instead of (as Du Chaillu wrote it) *koolookamba*. Sir Harry, however, could not agree with Mr. Rothschild's proposed change of the generic name of the Orang from *Simia* to *Pongo*; and although considering him right in applying the former name, at present used for the Orang, to the Chimpanzees, he was of opinion that either *Satyrus* or *Pithecus* was a far preferable name to *Pongo* for the Orang. He concluded the paper with a list of words used in several African languages for the name of the Chimpanzee, and with a *précis* of the history of European knowledge of the Anthropoid Apes down to the Eighteenth Century.

Mr. KNUD ANDERSEN contributed a paper on some species of Bats of the genus *Rhinolophus*, in the course of which he showed the progressive evolution from the Austro-Malayan *R. simplex* (allied to *megaphyllus*), through a long series of Oriental forms, to the W. Palæarctic *R. ferrum-equinum*, and a similar chain from the Oriental *R. lepidus* (allied to *minor*) to the W. Palæarctic *R. blasii* and *R. euryale*. *R. hipposiderus* was traced back to the Oriental *R. minor*. A slight difference between the British colony of *R. hipposiderus* and the Central European form of the same species was pointed out. All the Ethiopian species of *Rhinolophus* were shown to be of Oriental origin.

A paper was read from Dr. E. BERGROTH, C.M.Z.S., containing the results of his observations on the stridulating-organs and descriptions of five new species (two of which were referred to new genera) of the Hemipterous family *Halyinæ*.

Dr. P. CHALMERS MITCHELL, Secretary to the Society, read a paper entitled "On the Anatomy of Limicoline Birds, with special reference to the Correlation of Modifications." The paper dealt with the anatomy, chiefly muscular, of *Charadriidæ*, *Chionididæ*, *Glareolidæ*, *Thinocoridæ*, *Œdicnemidæ*, and *Parridæ*.

Mr. R. I. Pocock, F.Z.S., Superintendent at the Gardens, read a paper containing results of observations made upon a female specimen of the Hainan Gibbon (*Hylobates hainanus*), now living in the Society's Gardens.

The next Meeting of the Society for Scientific Business (closing the Session 1904–05) will be held on Tuesday, the 6th June, 1905, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Col. C. Delmé-Radcliffe.—Notes on the Natural History of Western Uganda. (Illustrated by lantern-slides.)

2. Mr. Martin Jacoby.—Descriptions of new Species of *Œdionychis* and allied Genera.

3. Dr. P. Chalmers Mitchell.—On the Intestinal Tract of Mammals.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
23*rd May*, 1905.

No. 21.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

June 6th, 1905.

Dr. HENRY WOODWARD, F.R.S., Vice-President, in the Chair.

The SECRETARY read a report on the additions that had been made to the Society's Menagerie during May 1905, and called special attention to a Crowned Duiker (*Cephalophus coronatus*) from West Africa, deposited on May 1st; to a Maxwell's Duiker (*Cephalophus maxwelli*) from West Africa, presented by Lt.-Col. Bartlett, R.A.M.C., on May 16th; to a Nepalese Hornbill (*Aceros nepalensis*) from the Himalayas, received in exchange on May 18th; and to two Sulphur-breasted Toucans (*Rhamphastos carinatus*), purchased on May 13th and 23rd respectively.

Mr. OLDFIELD THOMAS, F.R.S., exhibited a specimen of a new Bushbuck, which he proposed to call

TRAGELAPHUS HAYWOODI, sp. n.

Neck well-haired, without short-haired collar. Colour very dark, belly black. Dorsal crest black anteriorly, white on hinder back. Transverse stripes only three, very inconspicuous. Only three or four white spots on haunches. Horns very powerful.

Greatest length of skull 265 mm. Length of horn on curve 470 mm.; basal circumference 171.

Hab. Nyeri, British East Africa.

Type. Male. B.M. 5.5.16.3. Presented by C. W. Haywood, Esq.

Mr. OLDFIELD THOMAS also exhibited some mammals and birds from Japan which had been obtained by a collector sent out by the Society's President, His Grace the Duke of Bedford, K.G.,

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who, in order to show his sympathy with the technical side of the Society's work, proposed to further Zoological Science by having systematic collections made in that part of the world. The specimens would be laid before the Society from time to time, and after being worked out by specialists, would be presented to the National Museum.

Of the present series Mr. Thomas drew attention to a fine Marten which appeared to be different from the true *Mustela melampus*, and which he proposed to call

MUSTELA MELAMPUS BEDFORDI, subsp. n.

General colour olivaceous isabella, quite different to the golden yellow of true *melampus*. Throat and neck with a strongly contrasted yellow patch.

Hab. Nara district, Southern Central Hondo.

Type. Adult male. Original number 213. Collected by M. P. Anderson.

Mr. R. I. POCOCK, the Superintendent of the Gardens, exhibited a female specimen of the Jamaican Scorpion, *Centrurus insulanus*, carrying its young on its back. The specimen had been presented to the Society by Mr. H. Munt, F.Z.S.

Dr. P. CHALMERS MITCHELL, Secretary of the Society, read a paper entitled "On the Intestinal Tract of Mammals," and illustrated it by lantern-slides prepared from some of the drawings which he hoped would accompany the memoir on publication. In the course of the last eight years, the Author had taken every possible opportunity of studying the alimentary tract of Mammals from specimens that had died in the Society's Gardens, and had obtained additional material elsewhere, with the result that his investigations covered over two hundred individuals, and included the greater number of the Mammalian Orders. The paper described the Mammalian Intestinal Tract as being composed of three definite morphological regions:—the duodenum; Meckel's tract, which was derived from the pendent loop of Mammalian embryology, and was an outgrowth corresponding to only a very short part of the primitive straight gut; and the hind-gut. As compared with the disposition in Birds, the Mammalian duodenum was less specialised; Meckel's tract, which in Birds the Author had already shown fell into a series of patterns of systematic importance, was much more homogeneous throughout the Mammalian series; the hind-gut, which was of little importance in Birds, was developed in Mammals in varied patterns which had systematic importance. The Author showed that the single cæcum which was characteristic of Mammals was probably one of an original pair, and that the traces of this paired origin were much more frequent in Mammals than had been supposed. He stated that the primitive paired cæca of Mammals were homologous with those of Birds. The paper then gave a systematic account of the

characters of the intestinal tract in the different Mammalian groups, and concluded with the inferences as to the affinities of these groups that the patterns supplied.

Lieut.-Col. C. Delmé-Radcliffe, M.V.O., F.Z.S., gave an account, illustrated by a fine collection of specimens and a series of lantern-slides, of the Natural History of Western Uganda, deduced from observations and collections made by him while acting as British Boundary Commissioner on the Uganda frontiers.

Dr. H. Gadow, F.R.S., read a paper on the Distribution of Mexican Amphibia and Reptilia. After a critical revision of the species recorded from Mexico, the Author stated that he grouped them according to the prevailing physical features of the country. It was found that Mexico had received its present fauna from both the Northern and the Southern Continents. The Northern immigrants had spread over high tablelands and mountains, whilst not a few species had descended into the hot lowlands, even into Central America and still further south. On the other hand, the Southerners were divided by the plateau into an Atlantic and a Pacific mass, each having had time to modify many of its members according to the very different physical features. Scarcely any of these Southerners had ascended the plateau, but they were not averse to ascending high outlying mountains. A comparative list of species confined to high altitudes was given, and the conclusion arrived at, with the help of geological data and the fauna of the Antilles, was that the exchange between the North and South took place during the Miocene epoch, at which period alone the Antilles were connected with Central America.

Mr. G. A. Boulenger, F.R.S., described the new species of Reptiles discovered in Mexico by Dr. H. Gadow.

Mr. G. A. Boulenger also presented a paper containing an account of the Batrachians and Reptiles collected in South Africa by Mr. C. H. B. Grant and presented to the British Museum by Mr. C. D. Rudd.

Mr. F. E. Beddard, F.R.S., communicated some notes on the Anatomy of the Yellow-throated Lizard, *Gerrhosaurus flavigularis*.

Mr. Beddard also presented notes on the Cerebellum in the Exanthematic Monitor, *Varanus exanthematicus*, and on the Cerebral Hemispheres in the Taraguira Lizard, *Tropidurus hispidus*.

Mr. Richard Assheton, F.Z.S., communicated a paper on the Fœtus and Placenta of the Spiny Mouse, *Acomys cahirinus*. The paper pointed out that the fœtus, received from the Society's Gardens, was covered by a thin epitrichium which was perforated

by the stouter hairs. The placenta was discoidal and closely resembled that of the Mouse (*Mus musculus*). The trophoblast was greatly thickened, and formed a distal portion which was broken up into a system of large irregular spaces containing maternal blood, and a proximal portion with more regular channels containing maternal blood between which fœtal vessels extended. The proximal wall of the yolk-sac was very vascular and much folded, but the folds did not become involved in the placental tissue as in some other Muridæ. The course of the blood-circulation and details of histology were also described.

A paper was communicated by the Rev. H. S. Gorham on some new Coleoptera from South Africa. The Beetles referred to were of the families *Malacodermata*, *Cleridæ*, and *Erotylidæ*; and had been collected by Dr. H. Brauns of Willowmore, in Cape Colony, either at Willowmore or at Delagoa Bay in 1900 or 1901; and indicated that the Fauna of South Africa was rich in species of the two first families, and more so than had been supposed in members of the latter family. One new genus was described.

Dr. A. Smith Woodward, F.R.S., communicated a paper by Baron Francis Nopcsa entitled "Remarks on the supposed Clavicle of the Sauropodous Dinosaur *Diplodocus*."

This Meeting closes the Session 1904–1905. The next Session (1905–1906) will commence in November next.

The following Papers have been received:—

1. Mr. Martin Jacoby, F.E.S.—Descriptions of new Species of *Oedionychis* and allied genera (Phytophagous Coleoptera).

2. Dr. Walter Kidd, F.Z.S.—On the Papillary Ridges in Mammals, chiefly Primates.

3. Mr. F. E. Beddard, F.R.S.—On some points in the Vascular System of *Hatteria* compared with that of the Lacertilia and Crocodilia.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
13*th June*, 1905.

CONTENTS (*continued*).

May 16, 1905 (*continued*).

June 6, 1905.

LIST OF PLATES.

1905.—VOL. II.

PART I.

NOTICE.

The 'Proceedings' for the year are issued in *four* parts, forming two volumes, as follows:—

VOL. I.

Part I. containing papers read in January and February, in June.
II. " " " March and April, in August.

VOL. II.

Part I. containing papers read in May and June, in October.
II. " " " November and December, in April.

'Proceedings,' 1905, Vol. I. Part II. was published on August 10th, 1905.

The Abstracts of the papers read at the Scientific Meetings in May and June are contained in this Part.